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A MANAGEMENT SURVEY OF W. & L.E. GURLEY

1955

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PRODUCTION PLANNING AND CONTROL

PLANNING

Findings

Production planning consists of the systematic predetermination of the quantity of items required, the work time and processes involved, and manufacturing costs which are necessary in order to produce a stipulated number of products within a specified period of time in the most economical manner. Each step of separate operations should be "thought through" and planned for. The most efficient expenditure of time, human energy, material resources and working capital is accomplished by planning for production. Planning begins by determining what work shall be done, how it shall be done, where it shall be done and when it shall be done.

Production planning is a responsibility of the Planning and Control Manager. The Manager reports directly to the President of the Company. The scope and nature of the responsibilities of the Planning and Control Manager are not clearly defined. The major portion of production planning performed by this department consists of planning for the production of parts to be used in the assembly of engineering instruments and industrial equipment.

Present planning is based on a forecast of annual sales, prepared by the Sales Department. This forecast is broken down into quarterly quotas of products by type and model. The total number of parts needed to assemble the estimated quantity of end products for a year's sales is computed by deducting the number of parts in stock

27985

from the total number required. The resulting figure is the number of parts to be manufactured or procured otherwise.

Manufacturing lot sizes have been stipulated. These sizes have been estimated and have not been systematically determined. Some parts which require excessive set-up times compared to actual manufacturing time may be produced in sufficient quantities to sustain production of end products for a period of three years. Other parts are produced on a quarterly basis. The desired completion time for each job order for parts, expressed in weekly terms, is specified by the Planning and Control Manager. This desired completion time is arrived at by comparing the quantity of parts on hand against the average usage rate, thereby determining the quarter of the year in which the parts should be needed.

All production planning is not performed by the Planning and Control Manager. Department heads and foremen of some shops plan for production in their respective departments. (For example, Reticle Department, Carpenter Shop, Optical Shop) However, the methods used are similar in that planning is based on the sales forecast.

Planning conferences, attended by the Planning and Control Manager and all foremen, are held weekly. Future production plans are discussed as well as progress reports on current jobs.

One of the major factors currently contributing to the complexity of production planning is cyclical variations between actual sales and forecast sales. The annual forecast may prove to be accurate for the total year's sales but incremental breakdowns specifying demand for certain products are not accurate. Consequently, production

planning based on an incremental breakdown of the sales forecast does not provide for production commensurate with actual sales conditions. Because of this, routine production is sometimes curtailed in order to manufacture products to meet sales requirements or to fulfill an unexpected special order. In addition to curtailment of routine production for stock, these special or rush orders contribute to maladjustments in inventory investments.

Appraisal and Conclusions

To be effective, production planning must be based upon a combination of factors. A reasonably accurate sales forecast is needed to determine what products, and in what quantities, should be produced in a specific period of time. Information concerning plant capacity is also essential. The organization's inventory policies must be understood and considered while planning for production. Plans must also be aligned with Company policy regarding the level of employment, shutdowns and overtime.

A more modern concept of production planning includes development of precise standards of performance relative to product materials, production processes and production operation as a function of planning. Although this report, in the traditional manner, treats these major areas separately, it is believed that they must become an integral part of planning. It is obvious that changes in product design, production methods or procedures, and plant layout are factors that definitely affect production. More realistic and efficient plans can be prepared if all the factors affecting production are considered

in the preparation of these plans. While the installation and operation of a modern planning program is desirable, the present program with some modifications could be an asset to the organization. These modifications can be performed quickly with a minimum expenditure of capital; whereas the adoption of a modern program should be considered and approached as a long-range plan.

Production planning, as performed presently at W. & L. E. Gurley, is not considered to be adequate. The major factor contributing to the inadequacy of the present planning program appears to be the lack of information upon which planning must be based.

A sales forecast is available as an aid in determining what quantities of various products should be produced in a given period to meet expected sales through normal sales outlets. However, this forecast does not include the amounts and approximate time of sales of products ordered by customers, referred to as "special orders" by Company personnel. Neither does the forecast include demand expected for spare parts for sale or for use in repair work.

Available manufacturing capacity is not readily ascertainable because standard times established for operations are not realistic. Since persons other than the Planning and Control Manager plan for production also, the Manager cannot know what facilities are available for use in production of goods planned for by him.

The Company's inventory policy apparently varies from time to time. If employment is to remain constant, occasional high inventories must be accepted as necessary in order to accommodate fluctuating sales. The inventory policy should be defined clearly by

top management and readily understood by persons responsible for maintaining desired inventory levels and production planning.

Production plans are detailed estimates of a future situation. A plan, once established, should lend itself easily to needed changes. By studying it and considering the variables affecting it, a planner can arrive at conclusions regarding the what, how, where and when of production. He can foresee problems before they actually occur and he can apply corrective action to his plans rather than to an actual bottleneck situation with its attendant costs and inconveniences.

Recommendations

The following recommendations are offered:

1) That production planning be centralized as a responsibility of the Planning and Control Department head.
2) That top management prescribe in writing the responsibilities of the Planning and Control Department head regarding production planning.
3) That Company policies pertaining to inventory levels and level of employment be reconciled with fluctuating sales and clearly defined to the Planning and Control Manager.
4) That recommendations found in the Sales part of this report concerning sales forecasts and market research be carried out and that the estimated sales of spare parts be included in future forecasts.
5) That realistic time standards be set for operations.

6) That the Company investigate the desirability of installing and operating a modern planning program.

SCHEDULING

Findings

Production Scheduling may be defined as the fitting in of specific jobs into a general timetable so that:

1) Each component may arrive at and enter into finished stock or assembly in due order and on time.

2) So that orders may be manufactured in accordance with contracted liability.

Such a definition is deemed applicable to this discussion due to the mixed stock and custom manufacturing which exists at W. & L. E. Gurley.

The ultimate objective of scheduling the work activities of a productive enterprise is to insure that each unit of productive capacity (personnel or equipment) shall at any given time be performing that work task which is known to be of the greatest overall economic benefit to the enterprise.

Two separate schedules are needed in order to operate a scheduling system. A preliminary or master schedule is needed to adjust expected requirements with available capacity. This schedule is used to show the approximate time required to produce the expected quantity of products needed for a given period of time. Next a detailed schedule in terms of specific jobs or orders is needed. This schedule is used to assign operations to a particular work station by detailed time increments.

The general approximation of information normally expressed by a master schedule is derived from a set of work sheets prepared by the Planning and Control Manager at W. & L. E. Gurley. A sheet

contains for the following entries pertaining to work to be performed in the machine shops:

1) Part number
2) Name of part
3) Number of parts needed for one year
4) Total parts on hand
5) Manufacturing lot size
6) Set-up time
7) Manufacturing time for one hundred parts
8) Total time to manufacture year's requirements
9) First quarter
10) Second quarter
11) Third quarter
12) Fourth quarter
13) Number of parts left over at year's end
14) Cost per hundred parts
15) Total cost of parts for year's products

The number of parts needed for production of the products contained in the sales forecast is computed and entered on the work sheet. By comparing this total with the number of parts on hand, the amount to be manufactured is determined. If the need for parts is critical, the manufacturing lot size is entered on the work sheet in red pencil. If the quantity on hand is above the minimum balance but insufficient to sustain the estimated yearly production of products, the manufacturing lot size is entered under the quarter in which the lot of parts will be needed.

Records maintained in the planning department indicate finished products which use similar components. By referring to these records when preparing the work sheets the Planning Manager avoids duplication of computations on components used in more than one end product. Records are also available in the Manager's office which indicate particular machine set-ups that are applicable to similar operations on other parts. The scheduler can use such similar set-ups to perform the maximum number of operations requiring this set-up.

Inventory records for raw stock items are not maintained in the scheduling department. In order to ascertain the availability of parts for a job order the scheduler may call the raw stockroom clerk on the telephone and request the required information. Inventory records of finished stock items are maintained in the Planning Manager's office. However, when an assembly job order is issued, these records are not used to determine availability of finished parts. Consequently job orders are frequently returned to the Manager's office due to non-availability of required parts.

Completed work sheets may be used to determine when a job order should be presented to an operating department. Job orders are dispatched from the planning department in the form of job books prepared by the use of address-o-graph plates. The following information is stamped on the cover and on each of five pages of the book:

1) Part number
2) Name of part
3) Stock from which part is made

4) Code number of shop

5) Department in which work will be performed

6) Job number

7) Blueprint number

8) Quantity of parts to be produced

In addition the cover of the book shows the date the job order is released and the desired completion week. This book and a routing card which shows part identity, operations and sequence in which they are to be performed, and work stations by machine numbers is placed in a transparent envelope with a blueprint of the part concerned and delivered to the foreman of the shop in which the job will be performed. The envelope accompanies the job throughout its manufacturing cycle and is returned to the planning department upon completion of the job. At this time the routing card is returned to its file and the blueprint is destroyed. Various sheets of the job book go to assigned departments for use in preparation of historical data. However, the cover of the job book is discarded in the Accounting Department, having served no specific useful purpose throughout the life of the job order.

Detailed scheduling of work is performed by the foreman of the shop performing the work.

A planned weekly production schedule covering a period of eight weeks is prepared by the Planning and Control Manager and distributed to all foremen. This schedule lists the number of finished products by type and model, which are planned for production each week. This schedule is "firm" for the current week and the following week.

The succeeding six weeks' figures are subject to significant changes if the need arises. Weekly conferences, mentioned earlier, provide an opportunity for discussing adjustments to this schedule.

Production for custom orders, as well as special orders for engineering instruments and industrial equipment, frequently is given priority over normal scheduled production. Decisions to rush production of these orders are made by persons other than the Planning and Control Manager, resulting in unexpected changes to existing schedules. This practice also complicates the detailed scheduling of work performed by the foreman.

Visual aids to scheduling, such as charts or boards, are not used in the planning department or machine shops.

Appraisal and Conclusions

As stated before, general overall scheduling is performed by the Planning and Control Manager, while the detailed scheduling is performed by the foreman concerned. The methods used by the Planning and Control Manager to determine the total number of products to be manufactured are considered valid. His use of available records indicating machine set-ups applicable to more than one operation, and of interchangeable parts used in various end products are desirable features of the present scheduling system.

In order to schedule production the scheduler needs an accurate forecast of products to be sold, accurate and timely information on plant capacity available and in use, and realistic information concerning production methods and time standards. Regardless of the

time and conscientious effort applied to the preparation of a production schedule, the end results are meaningful only to the extent that valid, pertinent information is used as a basis for preparing the schedule. The essential information required from a sales forecast is partially supplied under the present system at W. & L. E. Gurley. A more accurate forecast, including all sales of instruments and spare parts, is definitely needed. Available manufacturing capacity is not systematically determined by, or for, the Planning and Control Manager. As no visual or mechanized charts or boards are used, capacity at any work station is ascertained by a telephone call or a visit to the department concerned. Even then the available capacity amounts to an estimate of the foreman. With a dozen or more job orders in the department and no visual consolidation of work to be performed, the foreman can scarcely do more than guess the capacity of a given work station.

"Produc-Trol" boards are available in the Company at the present time. While the eventual aim should be to provide visual aids to portray the work load planned and scheduled for each work station, a logical starting point could consist of the use of one board by the Planning and Control Manager. As comparatively few work stations consistently cause bottlenecks in production, one board would be adequate to portray the work load for these chronic trouble spots. At the same time, personnel maintaining this board could become familiar with its operation and appreciate its worth to their department. Another manner in which the use of only one board would be beneficial would consist of using the board to show the schedule

of the most valuable parts normally used. The method of deriving zones of parts according to their value is presented in the Inventory Control part of this report.

In the event that wholly desirable sales forecasts and methods of determining plant capacity were available and used by the Planning and Control Manager, the scheduling function could not be performed properly without realistic production methods and time standards information. The routing cards presently used show the sequence and number of operations to be performed and the work station at which the operation is to be performed. However, this information was not obtained in a systematic, factual manner. This is evidenced by the frequent deviations from the prescribed instructions. Time standards contained on the routing sheets are either the results of previously estimated times or a modification of these estimates, based on actual experience which has proved the original estimate to be significantly inaccurate.

A system of foreman control which places responsibility of planning, scheduling and controlling production within their respective departments has some merits and is commonly used in small manufacturing organizations. Being in close contact and proximity to men and equipment of his department, the foreman knows the limitations and capacities of each more intimately than a person of a centralized department could be expected to know them. The foreman is also aware of breakdowns or bottlenecks in his department as soon as they occur. A foreman's essential task is leadership training and supervision of his working team, the constant detailed adjustments which, even with

the best planning in the world, demand incessant attention if any actual manufacturing process is to go forward smoothly and effectively. However, a foreman is mainly concerned with the productive operations of his particular department. His attention is required within this department and he cannot be expected to coordinate plans, schedules and production to the extent that a centralized department would do. Since a planning and control department is already established, it should be utilized fully for the purpose of planning, scheduling and control. A centralized department could schedule work in such a manner as to result in the greatest overall economic benefit to the organization. A combination of a centralized and foreman control system is bound to result in wasted efforts being dissipated in various directions.

The practice of destroying blueprints upon completion of a job is considered to be uneconomical. This practice may have been justifiable before the use of transparent envelopes was adopted. However, under the present system blueprints should be used over and over unless they are damaged or rendered obsolete by changes. With proper coordination between the planning department, where the prints are filed, and the engineering department, where they are prepared, current prints could be used repetitively resulting in substantial savings. This is obvious when it is realized that an average of twelve jobs are issued per day.

The use of the job book cover could be discontinued without impairing any function of the scheduling or control system. These covers were needed for protection of the job sheets before the trans-

parent envelope was adopted. However, ample protection of the sheets is now afforded by the envelope and evidently the use of the cover is continued because of habit. The present (March 15 - April 15) usage rate indicates that twenty dollars is spent annually for material costs of the covers alone.

When a job order is presented to an operating department the foreman or a skilled machinist computes the number of parts needed to complete the job. This sometimes takes as much as thirty minutes of their time. There is available space on the present job sheets to show the number of parts needed to produce a given number of components. If this information were entered on the job sheet, it would eliminate the computations presently performed by foremen or machinists.

Foremen and machinists also spend a considerable amount of time requisitioning and transporting parts. As other personnel are available to perform these tasks, this is considered to be an uneconomical practice.

Recommendations

The following recommendations are offered:

1) That all scheduling be a responsibility of the Planning and Control Department head. By relieving foremen of this responsibility they could devote more time and effort to their primary duties.
2) That the Planning and Control Department use the revised type of inventory cards recommended in the Inventory Control part of this report as an aid to scheduling in lieu of the work sheets used at present.

3) That the use of visual, mechanized charts or boards be initiated immediately.

4) That all parts be delivered to the operating departments by stockroom attendants or material chasers.

5) That the number of parts needed to complete one hundred components be computed and entered on applicable job sheets by personnel of the Planning and Control Department.

6) That use of the cover on the job book be discontinued upon exhaustion of the present stock.

7) That books of job sheets interlaced with carbon be used in preparation of job orders. This would reduce the stamping operations from six to one.

8) That blueprints not be destroyed unless damaged or rendered useless by a change.

CONTROL

Findings

The objective of production control is the maximum production of goods with the minimum amount of confusion and expense. Control is the initiation of planned schedules and a series of functions which coordinate the available plant facilities and regulate the orderly movement of goods through their entire manufacturing cycle, from procurement of raw materials to the shipment of finished goods at the proper time and place in the required quantity.

Previously planned schedules are initiated by the Planning and Control Department by the issuance of job orders which specify the desired week of completion. Starting dates not being specified, the foremen determine the time at which work shall commence on a job.

Machines to be used, sequence of operations and specifications accompany the job order in the form of a routing sheet. The coordination of available plant capacity is performed at the foreman level. The foreman also obtains stock from the storerooms and regulates the movement of goods through the manufacturing cycle.

The Planning and Control Manager has no formal mechanism for indicating use and availability of plant facilities. A degree of control is exercised by checking the information entered on the job book when it is returned to the Planning and Control Manager as completed. The quantity actually manufactured and the completion date can be compared with those specified. The ledger, in which job orders are recorded in numerical order, is reviewed periodically in order to

report to top management the ten oldest outstanding jobs. When a completed job book is returned to the planning department the completion date is stamped in the ledger. Also, the book is matched with a previously filed job sheet and the filed sheet is relocated to a "completed" file and filed in numerical order.

Advances and changes in manufacturing quantities are effected without notification or approval of the Planning and Control Manager.

Appraisal and Conclusions

The objective of production control, as defined in this report, is not attained at W. & L. E. Gurley. Of necessity the major factors contributing to this situation have already been discussed in connection with planning and scheduling. Control would become a relatively simple task of direction and follow-up of production if effective planning were performed and realistic schedules were prepared and adhered to.

Direction is presently a responsibility of the foremen in charge of departments. The Planning and Control Manager is charged with the responsibility of control, but a system of foreman control is found to exist in the Company.

Follow-up on planned production is not systematically accomplished. Due to the latitude of time allowed in the completion of a job, control exercised by the Planning and Control Manager is minimized. Corrective action should be applied as soon as possible after significant deviations from the desired standards occur. Because no systematic methods of progress reports or follow-up procedures are used,

the cognizant control agency frequently learns of deviations from planned schedules too late to apply corrective action.

Recommendations

The following recommendations are offered:

1) That production control be a responsibility of the Planning and Control Department head only.
2) That necessary authority be exercised to insure that production schedules are adhered to.
3) That a system be established so that actual production may be compared to planned or scheduled production. In such a system the use of charts or boards is strongly recommended.
4) That the use of the job book ledger be discontinued. An additional copy of the job sheet, filed in chronological order, would furnish the same information with a smaller expenditure of time and effort.

Summary

The primary objective of this part is to accentuate the need for the adoption, installation and operation of a modern production planning and control system. No attempt has been made to outline a system specifically tailored to meet the needs of W. & L. E. Gurley. A complete system could be designed to meet the needs of the Company. However, this could be an unnecessary expense if the system were never installed or operated properly.

Certain fundamental principles govern production planning and control under any given set of conditions. Knowledge of what these principles are, when they work and why they work, shows that there is a basic system which can be made to work efficiently under any and all conditions. Personnel presently employed at the Company are familiar with these principles and are considered capable of designing a system to meet the needs of the Company.

The modern method of control stresses preplanning and foresight, with adequate means of measuring actual performance against plans or predetermined standards. This method permits corrections to be applied before damage has resulted. The old method of stock chasing discovers mistakes through hindsight, after the damage has been done.

The primary requisite for efficient production control is the absolute support of top management. If top management desires modern control methods, it must face the difficult tasks of revamping the old system, and inducing individuals to work as a team for the sake of a common goal.

Installation of a system will most likely present the major problems. Management must actively support the system and sell it to all employees. Again no specific method of installation is advocated.

Production Planning and Control is not a cure-all but it does make possible the best utilization of the existing capacity of the Company. The system, if properly operated and supervised, will become in time the recognized normal way of doing business.

PART VI

PURCHASING

Findings

General. Personnel of the Purchasing Department consist of one fulltime employee, the purchasing agent. He is assisted in his work by a secretary who divides her time between duties for the Purchasing Department and for the Accounting Department. The purchasing agent reports directly to the Plant Manager; his desk and all purchasing records, however, are located physically in the accounting office.

Purchase Requisitions. All purchases are initiated through the preparation of a standard purchase requisition (Figure VI-1). A requisition may be prepared and forwarded to the Purchasing Department by any one of five different ordering departments. These departments are:

1) Department 15 (Rough Stockroom)
2) Department 21 (Cabinet Shop)
3) Department 18 (Lens Shop)
4) Department A (Anemometer Shop)
5) Department 2 (Shipping Room)

All purchase requisitions, with the exception of those from the Shipping Room, are sent to the Plant Manager for approval prior to their delivery to the Purchasing Department. Requisitions from the Shipping Room are sent directly to the purchasing agent. It may be well to mention at this point that no routine has been established for

REQUISITION

Order

No. ______________

Date ______________

The following material is required for Order No. ________________,

for Department No. ______________ .

From ____

____

____

Ship by Express ________ Parcel Post ________ Freight ________

Quantity	Description

Approved ______________

Figure VI-1 (Purchase Requisition Form)

inter-office routing. Although several persons in the plant, notably the elevator operator, spend some time performing this duty, most deliveries are effected by personnel of the forwarding department at their convenience.

Upon receipt of a purchase requisition bearing the approval of the Plant Manager, the purchasing agent determines the proper vendor and the current unit cost of the material, and prices the order. At regular intervals (usually semi-weekly) a resume of current requisitions showing price and intended use is taken to the President for final approval. Such approval constitutes authority to order. In case a requisition is not approved the originating department is notified by the purchasing agent via telephone. The requisition then is destroyed.

Approved requisitions are grouped according to type of material and are held by the purchasing agent (unless necessity prohibits) until total requirements for a particular item or type of material constitute an economical ordering quantity. Standard ordering quantities have not been determined for specific types of material. Rather, the quantity ordered (and therefore the ordering date) depends upon the judgment of the purchasing agent who balances the requirement for the material, based on information from the Plant Manager plus much experience, against the saving effected by ordering at higher quantity levels. The importance of such decisions can be appreciated by considering the purchase of brass tubing at several different quantity levels. During a recent period, for quantities under three hundred pounds, the total price per pound was base price plus twenty-five cents. For quantities between five hundred and one thousand

pounds base price plus two cents; and for quantities between two and five thousand pounds, base price plus one and one-half cents. Since many requisitions are for quantities much less than those considered economical for order, a purchase order will frequently cover the requirements for several different requisitions.

Purchase Orders. Actual purchase of an item is accomplished through the preparation and forwarding of a standard purchase order. (Figure VI-2). This order is prepared in quadruplicate and the original forwarded to the vendor. Disposition of the three remaining copies is as follows:

1) The first (blue) copy is sent to the Receiving Department. Upon receipt of an order or part of an order, this blue copy accompanies the material to the ordering department. If all material listed on the copy is received and in good order, the copy is certified and returned to the Purchasing Department. When portions of the order are received at different times, the copy is marked to show which items have been received and sent to the Purchasing Department. A record is made of this partial shipment and the copy is returned to the receiving department. This procedure is repeated until all material has been received. Differences between quantity ordered and quantity received, or information concerning unsatisfactory condition of material, are noted on the copy by the ordering department. Provision is made at the bottom of this copy for recording information as to condition of material, method of shipment and date of receipt.

[illegible]
W. & L. E. GURLEY
Engineering Instruments
Standard Weights and Measures
Troy, N. Y., U. S. A.
Cable "Gurley"

[illegible]

No.
DEPT. ______________

1. Order number and dept. number must appear on each package and on invoice.

2. Duplicate invoices required together with Bill of Lading or Express receipt.

3. This order must be acknowledged and approximate date of delivery stated.

4. All goods are subject to our approval.

5. Goods covered by this order to be guaranteed produced in accordance with the Fair Labor Standards Act of 1938.

TO:

PLEASE SHIP THE FOLLOWING MATERIAL VIA ______________

QUANTITY	DESCRIPTION

W. & L. E. Gurley

By ______________________
Purchasing Agent

Figure V1-2 (Purchase Order Form)

2) The second (yellow) copy is retained by the Purchasing Department. These copies are filed alphabetically, by vendor, and are used for follow-up and expediting and for recording partial shipment of orders.

3) The third (white) copy is normally sent to the department initiating the purchase, to be used for local records.

Ordering Departments. Before describing in detail the action taken by the Purchasing Department as a result of placing an order, and the receipt of material, it may be advisable to discuss the systems used by the various ordering departments to enable them to determine the necessity for material requisition and to describe records maintained to determine the current status of such requisitions.

1) Department 15 (Rough Stockroom). This stockroom is concerned mainly with the receipt and issue of metal raw materials, chemicals, bulk liquids, hardware and tools. The proper functioning of the stockroom is the responsibility of the Plant Manager, while the actual ordering, receiving and issuing duties are performed by the two permanently assigned stockroom clerks.

A card file system of perpetual inventory is maintained for all items stocked. Each card specifies the minimum inventory level and ordering quantity and provides space for recording material requisition information.

Requisitions are prepared in duplicate and assigned a local number. The original is sent to the Plant Manager for approval and the copy is retained and filed numerically. This file is referred to

locally as the "unconfirmed" file. Upon receipt of the white copy of the purchase order it is filed chronologically and becomes part of the "confirmed" file. At this time all requisitions pertaining to the order are removed from the unconfirmed file and placed in a storage file. Upon receipt of material, accompanied by the blue copy of the purchase order, a check is made as to both quantity and condition. The blue copy then is certified and sent to the Purchasing Department. The white copy of the order is removed from the confirmed file and placed in a storage file. As far as could be determined, no further use is made of either of the storage files.

2) Department 21 (Cabinet Shop). Items ordered through this shop consist mainly of lumber for instrument cases, tripods, rods and tables and leather for instrument case covers and handles. No material stockroom exists as such. Rather, raw materials are stored in designated areas near the shop. Issue of materials is carried out by oral instruction and no record is made of any individual issue.

No inventory records are kept in this department. The shop foreman constantly surveys the material remaining and decides when to send requisitions for additional items. He also determines the order quantity. All requisitions are prepared by the foreman. A single copy is filled out and sent to the Plant Manager for approval. At the present time the foreman does not receive the white copy of the purchase order, at his own request.

Upon receipt of material it is inspected and the blue copy of the order is certified and sent to the Purchasing Department.

3) Department 16 (Lens Shop). Ordering in this department is almost entirely for optical glass. Ordering and record-keeping is carried out by the shop foreman.

A card system of perpetual inventory is maintained for all items ordered. Minimum levels and ordering quantities are specified for all items. This information is considered by the foreman to be outdated, however, and all figures are being revised to meet current requirements. Revised quantities are based on the judgment of the foreman, a man of considerable experience.

Material requisitions are prepared in duplicate. The original is sent to the Plant Manager for approval and the copy is retained and filed by date of requisition. When the white copy of the purchase order is received, it is filed alphabetically by vendor. When all material listed on the order has been received and the blue copy of the order has been returned to the Purchasing Department, local records of both requisition and purchase order are destroyed. Decision for such action was made after it was determined that the Purchasing Department maintained historical records of both of these forms.

4) Department "A" (Anemometer Shop). Purchase requirements for this shop are mostly for small electrical and electronic parts and components such as connectors, plugs, resistors, small motors and generators and so forth. Purchase requirements are determined by the shop foreman.

Material in this shop is stored by item in open-faced bins. Each item carries a card attached to the bin showing description of

the item, a record of issues, material received and the quantity remaining. No formal system of minimum levels or ordering quantity is used. Instead the foreman monitors the level of all items by sight and determines when to order and the size of the order.

A standard requisition is not filled out in this shop. Required items are listed and the list is sent to the Plant Engineer, or the information is transmitted by telephone. A requisition is prepared then by the Plant Engineer and sent to the Purchasing Department via the Plant Manager.

White copies of the purchase order are received in the Anemometer Shop and filed chronologically. When material is received and the blue copy of the order has been returned to the Purchasing Department, notation of receipt is made on both the inventory card and the white copy of the order. This copy of the order remains in the file.

5) Department 2 (Shipping Room). The Shipping Room is considered part of the Sales Department. Material ordered for this department consists mainly of paper, cartons, excelsior, twine and other items needed for packaging and shipping. On-hand items are stored both in the shipping room and in an adjacent building. All requisitioning and record-keeping is done by the chief shipping clerk.

A group of inventory cards is maintained for items used in this department, but these cards contain no information concerning minimum inventory levels or ordering quantity. Both the frequency and size of orders are based on the judgment of the chief shipping clerk. No records of requisitions are kept, nor are white copies of purchase orders received.

Purchasing Department. When a purchase order is forwarded to the vendor, copies of the order are distributed as already described. At this time information concerning the order is listed in a Summary of Purchases Journal. Entries are made by order number and show the following information:

1) Material
2) Quantity
3) Price (estimated from the most recent catalog or quoted unit price)
4) Vendor
5) Productive or non-productive material (Productive material is that which eventually becomes part of a finished product.)
6) Month of expected payment

Information on a particular order is lined out when the order is approved for payment.

A file is established also for each purchase order. The file is identified by purchase order number and contains the requisition(s) included in the order and any other documents pertaining to the order. All future correspondence or other information concerning the order will become part of this file.

The file of purchase order copies (yellow) is reviewed by the purchasing agent periodically. If in his opinion follow-up is necessary, appropriate action is taken. If time permits, such action normally will consist of a letter to the vendor. If it appears that the item will become critical, however, or if the Plant Manager has expressed a need for expediting, emergency action will be taken. The

usual method for expediting is by use of the telephone, authorizing special transportation if necessary. If emergency measures are indicated at the time a purchase order is forwarded, a telephone call may be used to supply purchase order information to the vendor and to request shipment prior to receipt of the order form.

When material has been received and the blue copy of the order has been certified and returned to the Purchase Department, this copy is placed in a special file. At this time the yellow copy is pulled from the alphabetical file and destroyed. When the vendor's invoice is received, the purchasing agent will approve the invoice and give it to the secretary. The blue copy of the purchase order then will be placed with other information concerning the order and the entire file will be put in storage. The secretary will prepare a check (voucher type) for signature by the Treasurer, and record pertinent information in a Voucher Register.

When an invoice is received in the Purchasing Department prior to the receipt of the certified blue copy of the order, a check is made to determine the status of the material. If the order carries a discount and a deadline date, payment will be made on bill of lading. Otherwise the invoice will be held until the certified copy of the purchase order is received.

Each time an invoice is approved for payment, the price of the invoice is entered in a Material Inventory Journal. This journal shows the total current inventory in dollar value for each ordering department. At monthly intervals material issue slips for specific

job orders are collected and priced. Unit prices used are those determined from the most recent invoice for that item. Totals for each item are compiled and credited to the proper departmental inventory. The issue slips are priced in duplicate, with one copy (white) being saved for audit purposes and the other copy (yellow) being sent to the Accounting Department to be used in costing specific jobs.

A physical inventory is taken annually and the totals in the Material Inventory Journal are adjusted at that time. Variances in inventory are charged or credited directly to Profit and Loss. Inventories are taken by personnel of the department concerned.

In addition to the records already mentioned two card files are maintained by the Purchasing Department.

1) A Voucher Number File. This file consists of 3 x 5 cards filed according to vendor. Each card is numbered and shows the full name and address of the particular vendor. Each entry on a card shows the month and year, voucher number and amount paid. The file is used both as a cross-index to furnish voucher information and as a record of prior purchases from specific vendors.

2) A Material Cost File. This file consists of 4 x 6 cards filed (by means of a code) by material item. The card shows the code number and the name of the item. Each time this item is purchased an entry is made on the card showing:

a) The purchase order number

b) The vendor's number

c) The vendor's name

d) Date received

e) Quantity received

f) Value of purchase

g) Unit cost of the item

This file is used when pricing job order material issue slips.

As far as was determined the only material sold for salvage is scrap metal. When a sufficient quantity has accumulated, a scrap dealer is contacted. The dealer lists the items and quantities of scrap material and this list is checked by the purchasing agent. Receipts from salvage are listed as Miscellaneous Income.

The purchasing agent states that the Company does business with relatively few vendors and that in most cases the Company has been dealing with these same vendors for many years. Two essential reasons for such a policy are:

1) Some vendors supply the Company with non-standard items such as special castings and tubing. In many such cases Gurley has paid for special tools used by the vendor (usually a special die). A change in vendor would necessitate an additional investment in duplicating this special tooling.

2) The Company feels that the goodwill built up with the vendors as the result of many years of successful business dealings is paying dividends in the form of ease of communication and in consideration on the part of the vendors for Gurley orders.

Although the Purchasing Department supplies considerable information to the Accounting Department, there appears to be only one formal report submitted to top management. This report is prepared the first of each month and contains the following information:

1) Inventory value as of the first of the previous month
2) Value of material purchased during the previous month
3) Value of material withdrawn during the previous month
4) Value of material purchased, year to date
5) Value of material withdrawn, year to date
6) Current inventory value
7) Inventory value as compared with previous year (expressed as a percentage).

Appraisals and Conclusions

Duties and Responsibilities. At the present time the authority of the purchasing agent is limited severely. Although he does exercise some control over the size (and therefore the date) of specific purchase orders, he is unable to effect any purchase without prior approval of the purchase requisition by the President. In addition he is seldom if ever consulted concerning economic ordering quantities, as is evidenced by the quantities appearing on individual requisitions. In general he simply processes requisitions approved by the Plant Manager and reapproved (and sometimes modified) by the President.

The duties of the purchasing agent are not defined in writing. Although such duties are well understood by the present purchasing agent, lack of a written job description is considered to be a potential source of confusion. In addition, if the duties of the purchasing agent were determined properly, and clearly stated in writing, it is believed that his actual authority and value in the Company would be increased greatly.

The same lack of job description exists in the case of the secretary. Since the duties of this position affect both the Purchasing and Accounting Departments, a written job description is considered necessary in order to assure that the work for both Departments is accomplished efficiently. A concise and accurate description of the job content would assist the secretary in planning and scheduling her work and should help to eliminate confusion and misunderstanding between the heads of the Purchasing and Accounting Departments in cases of conflict. Because of the experience of the present employees in these positions the necessity for job descriptions is not particularly apparent. Lack of such descriptions, however, could lead to considerable inefficiency and expense in case of employee change or extended absence.

Material Requisitioning. One surprising feature of the purchasing system is the extreme decentralization of the material requisitioning function. At the present time there are five separate locations for material requisitioning, storage and issue. As might be expected, there is a different system used for requisitioning, stock control and record-keeping at each location. In spite of this duplication of effort most of the ordering departments still do not achieve independent stock control. For example: although the foreman of the Cabinet Shop controls the ordering and issue of lumber, he is dependent upon the Rough Stockroom for most of the hardware and painting supplies needed for fabrication of his products.

Another source of inefficiency lies in the number of people

used to carry out the stock control and requisitioning functions. In addition to the two fulltime clerks in the Rough Stockroom, at least four other employees spend a portion of their time performing these duties. And of these four, three are department foremen and the other is the chief shipping clerk.

In at least one case, the Lens Department, it appears that the formation of an additional ordering department was the result of what was considered to be unsatisfactory service on the part of the Rough Stockroom. Such service apparently was the result of unfamiliarity on the part of the stockroom clerks with certain material items. While it is realized that such a situation can result in much annoyance and excessive costs, it would seem that the proper solution would have been indoctrination of the clerks. Certainly a stockroom which controls the ordering and issue of such diversified items as metals, chemicals and tools can handle properly the different necessary types of glass (and for that matter, lumber, shipping supplies and electrical parts).

From the above it can be seen that there is need for a centralized stock control and requisitioning system. If most inventory could be located physically in one area, so much the better. Failure to create such a central stockroom, however, should not interfere with the centralizing of the control and requisitioning functions. Even if an additional stockroom clerk were needed, though such may not necessarily be the case, the cost would be more than offset by the release of the foremen and shipping clerk from these routine duties.

In order to request properly items for purchase, logical minimum inventory levels and optimum ordering quantities must be determined. Although the determination of these quantities will be dealt with more completely in the Inventory Planning and Control part of this report, it will be stated here that any system used should take into account the fact that in many cases requirements for a single item of material will not comprise an economical ordering quantity. In such cases delivery time is more a function of the average frequency of requisitions for this type of material than of the normal time from placement of an order to delivery of the material.

The following requisitioning procedure is suggested for a centralized stock control and requisitioning office:

1) All material requisitions would be made out in duplicate and assigned a number. The duplicate would be retained and filed numerically. Record of this requisition would be made also on the individual stock card, showing date, requisition number and quantity.

2) When the white copy of the purchase order is received, it should indicate which individual requisitions are included in the order. This copy should be filed by order number and a notation of this number should be made on the appropriate requisition copies.

3) After the blue copy of the purchase order has been certified and sent to the Purchasing Department, pull out and destroy the white copy of the purchase order and all applicable requisition copies. Notation of the receipt of the material will be made on the stock card.

With such a system in use reference to the stock card will

show immediately whether an item has been requisitioned and when. From the requisition number on the card the requisition file can be examined to determine whether the material has been ordered. If it has, the purchase order number will be indicated and the order file can be used to determine the order date and the actual quantity ordered. Additional information can be obtained from the Purchasing Department by specifying the purchase order number. In cases where information is needed concerning a particular purchase order the order file can be used to determine which requisitions are involved. The requisition file will show then which items of material are involved.

Records. Records are maintained in the Purchasing Department which, for the most part, are considered to be adequate. The use of a separate file, by purchase order number, for the inclusion of all information concerning the order, seems to be an excellent method for complete and ready reference. One item which might facilitate the identification of correspondence with the proper purchase order would be to change the first note on the purchase order form to read: "Order number and department number must appear on each package, on the invoice and on all correspondence concerning the order".

The Summary of Purchases Journal is considered to be quite valuable. Since the Journal lists not only the essential information found on the purchase order but also other information (productive or non-productive material and date of expected payment), it serves not only as a daily reference but also as an excellent source of material

for financial reports.

The alphabetical file of purchase order copies (yellow) serves as a cross-index for outstanding orders, as a means of recording receipt of partial orders and as a source of information for follow-up action. As to this latter function the file is considered to be inadequate. Although the system appears to operate satisfactorily at present, such success is due primarily to the experience and ability of the purchasing agent. No set time has been designated for checking the file and, since there is no information on the order copy to indicate expected date of delivery, any routine follow-up action taken is based entirely on the opinion of the purchasing agent as to whether an order is overdue.

This problem might be solved by the addition of another copy to the purchase order form. This copy could be filed by date for follow-up and destroyed with the present yellow copy. A daily examination of the file would indicate orders on which follow-up action is considered necessary. If all vendors would comply with note number three on the purchase order form (Orders to be acknowledged and approximate date of delivery stated), any necessary adjustment could be made in this file prior to filing the vendor's acknowledgment.

The *Material Inventory Journal*, as now used, is considered to be unsatisfactory both as a method of determining dollar value of current inventory and as a system for inventory control (when so used), except during a period of stable prices. To illustrate: consider an item of material during a period of rising prices. All material re-

ceived at the beginning of the period is debited to the inventory account at the current (lower) price. All material used is credited to the account, also at the current (lower) price. Material received towards the end of the period will be debited at the current (higher) price and all material used towards the end of the period will be credited at the current (higher) price. Under such a system the dollar value of the inventory will represent a unit cost which will vary according to the usage rate at different times during the overall period. When a physical inventory is taken, however, material on hand will be valued at the current (higher) price. In such a case poor inventory management may be obscured completely. The opposite can occur during a period of lowering prices.

Both the Voucher Number File and the Material Cost File are considered to be necessary and adequate.

Vendors. The Company's policy concerning their dealings with established vendors is considered to be sound. It is believed, however, that the financial results of such a policy should be evaluated periodically. One method of determining these results would be to have the Purchasing Department periodically compare the approved vendor's prices on certain high value items with those of competitors. A report could be prepared showing the items considered, vendor's price, competitor's price, amount of material purchased during the period and the savings to be effected, if any, as a result of price differential. Other information such as the special tooling already mentioned could be included also. This report could be prepared annually and a de-

cision could be made as to whether any material cost premium had been more than offset by other considerations such as service and so forth.

Another valuable report, and one which could be used in conjunction with the above information, would be one prepared annually showing failure of specific vendors to deliver on time.

Dependence upon a single vendor for material items should be avoided whenever practicable. It should be the responsibility of the Purchasing Department to establish and maintain a reasonable diversification of vendors and to distribute purchases in such a manner as to assure efficient acquisition of material items and at the same time to protect the Company against the effects of unsatisfactory service on the part of any particular vendor.

As far as could be determined, no system is in effect for recording the receipt of material of unsatisfactory quality. When items of sub-standard quality are received (as determined from inspection upon receipt or from subsequent difficulty during manufacture), a notation could be made on the vendor's card in the Voucher Number File. This file should be reviewed periodically by the purchasing agent to determine whether purchasing should be discontinued in the case of any particular vendor. The file could be used also to record failure of specific vendors to deliver on time.

The system for selecting vendors seemed to be quite informal. Different catalogs listing the same item are used by the purchasing agent and the decision as to which to use seems to be the result of his personal experience. A less experienced employee called on to carry out purchasing duties would have difficulty in making proper de-

cisions without studying first historical records. It would seem advisable to prepare a list of material items used and to designate the approved vendor. This list could show reasons, if any, why the Company had selected this particular vendor.

Recommendations

As the result of the findings and analysis of the purchasing function at W. & L. E. Gurley Company, it is recommended that:

1) The duties of the purchasing agent, and the secretary, be defined in writing and the purchasing agent be allowed full responsibility within the limits set forth. Types and amounts of purchases considered to be normal should be defined and such purchases should be handled entirely within the Purchasing Department.
2) The purchasing agent work closely and continuously with those responsible for the planning and control of manufacturing operations. The purchasing agent should be thoroughly familiar with the scheduling of all parts, sub-assembly and final assembly manufacturing, and with the material items required in each case. By utilizing this information and by coordinating with the persons responsible for inventory planning and control, proper minimum inventory levels and ordering quantities can be determined. The responsibility for such coordination should be outlined clearly in the purchasing agent's job description.
3) The stock control and requisitioning activities for the entire plant be centralized.

4) A file be set up by date to indicate the need for follow-up action on outstanding purchase orders.

5) The Material Inventory Journal not be used for the purpose of checking physical inventory.

6) A recognized consistent system of inventory evaluation (LIFO, FIFO, Average, etc.) be used when pricing inventory in the Material Inventory Journal.

7) A report be prepared annually showing the differential between vendor's and competitor's price for certain high value items.

8) A report be prepared annually showing failure of specific vendors to deliver on time.

9) A list of approved vendors be compiled by the Purchasing Department and referred to before placing an order for material.

10) The Purchasing Department establish and maintain to the maximum extent practicable a system of multiple vendors for material items.

11) A record be made of all material received which does not meet quality standards and this information be used by the purchasing agent to determine the allocation of future purchases.

12) When purchase requisitions are disapproved, notation be made on the form, preferably by rubber stamp, and the form returned to the stock control office.

13) Requisition numbers assigned by the stock control office be listed on the applicable purchase order form.

14) The Purchasing Department insist that all vendors comply with note number three on the purchase order form (Order to be acknowledged

and approximate delivery date stated).

15) Note number one one the purchase order form be revised to include a request for purchase order number on all correspondence.

PART VII

INVENTORY PLANNING

Inventory planning requires the development of inventory policies, procedures, controls and methods of operation.

Findings

The latest organization chart of W. & L. E. Gurley shows a Planning and Control Manager responsible to the President. The duties of the Planning and Control Manager include inventory planning and control.

Inventory planning as now performed for transits, levels, alidades and, partially, for industrial testing equipment is based upon sales forecasts, bills of material furnished by engineering and from inventory records maintained in the Planning and Control Office of stocks available. Annual material requirements are prepared manually on large spread sheets showing part numbers, quantities required per type and model, total quantities required per sales forecasts, quantities on hand and quantities required to support sales forecasts. Job orders for manufacturing of inventory shortages are released during the quarters indicated by the above planning, specifying completion weeks and quantities that vary from a quarter's supply to more than three years' supply. Only mental "recall" consideration is given to presently issued job orders and to the rate of requirements. Spoilage and estimates of materials required for repairs are planned for jointly by a blanket increase of job orders by ten percent of annual forecast needs.

Inventory planning for wood products, optical products and reticle products is performed by the foremen and the engineering in charge of these respective products. In general, plans are based in varying degrees upon sales forecast, bills of materials, stock available and shop equipment and shop personnel utilization. Job orders to cover these planned inventories are released by the Planning and Control Manager on the request of the foreman or engineer in charge of the products.

Raw materials are the charge of a clerk assigned to the Planning and Control Manager. Minimums have been set on raw materials by this clerk from several years of past experience. These minimums are unrealistic and are not used presently. When minimum quantities are reached, the Raw Materials Clerk notifies the Planning and Control Manager, usually by word of mouth, and usually a word of mouth decision is rendered regarding how long to wait before ordering and how much to order. Effort is not made by either this clerk or his manager to review items of same material content prior to placing a requisition even though discounts are realized when quantity purchases are made on many different items of same material content. For example, if less than three hundred pounds of brass rod is ordered, base price plus twenty-five cents per pound is paid; if more than five hundred pounds but less than one thousand pounds is ordered, then base price plus six cents per pound is paid; and if more than two thousand pounds is purchased, base price plus one and one-half cents per pound is paid; and so forth.

During the past four years Dr. Raymond Villers made a survey of W. & L. E. Gurley for the purpose of reducing by proper control and

scheduling the inventories of finished parts for transits, levels, alidades and industrial testing equipment. A new philosophy of inventory planning was advocated and many changes were initiated. Nevertheless the present policies, procedures, systems, controls and methods of operation are very fluid and seem to change at will. Replenishment policies fluctuate frequently; e.g., manufacturing or purchasing from an estimated quarter's supply to several years' supply. Procedures vary without consistency. For example we see the requirement of written requisitions sometimes and oral requests at other times; or even the announcement that "I took (a certain number) of (a certain part name)". The establishment of minimum quantities is made on the basis of intuition as each situation arises.

Form design, paper work required and office layout and records locations require the use of excessive clerical work. A spread sheet showing all part numbers of proposed production must be tabulated manually; at least five separate forms must be stamped to issue a single job order for finished parts, plus additional duplicative logging; and to refer to the stock cards requires walking approximately ten feet and return. Inventory records do not show (i) requisition dates nor dates upon which material is required, (ii) allocation date, (iii) maximum quantities or expediting points, (iv) unit costs, (v) balance available (as at times parts are advanced by manufacturing shop personnel in excess of needs and the excesses are not returned to the storeroom), (vi) economic lot quantities; (ordering quantities are specified but have not been determined systematically at management level), (vii) nor do they incorporate a control system which will permit effective

appraisal evaluation. The present inventory planning is not understood clearly by all personnel involved, and the responsibilities and functions of individuals are not spelled out.

Appraisals and Conclusions

Such systems fail to meet fully the usual concepts of planning and control. In a small company maybe the present system can be tolerated without too adverse effect but if the brief observations of shortages, unaccountability for material manufactured and/or issued, and the random methods of issue are typical of normal operations, it is apparent that present inventory planning and policies should undergo improvement alterations.

Effects of in-process inventory upon earning potential. The obtaining of inventories requires an outlay of working capital and the storing of these inventories ties up this invested capital. Material in process, except for the period during which productive work either changes its physical characteristics such as size, shape and outward appearance or joins one material to another, is either in storage or in transit whether it be a matter of moments while awaiting an immediate impending operation or whether it be for a period of minutes, hours or days. An analysis of overall production time in most industries shows that a larger part of the overall time is consumed in storage and material handling between productive operations than is consumed in productive work. As shown in the Process Flow section of this report the number of temporary storages exceeds two times the number of productive ("do") operations, while the number of material handlings

approximate the number of work operations. These storages and material handlings operations tie up working capital just as effectively as does storage of finished goods, but in the case of finished goods there is a possibility of sales and its profitable effect upon turnover. The more the material in process is moved from one operation to another and the more it is stored between operations, the longer the period of investment of working capital in its material and labor, and the longer before it can be sold; hence the desirability of reducing the number of movements to a minimum and of reducing the in-process storages to a minimum. The amount of in-process inventory is governed to a considerable degree by the length of the productive process. The greatest economy of process time is obtained when the following conditions are met: (1) the number of movements is reduced to a minimum; (2) when the work can move directly and immediately from one process to another; and (3) when each process time is a minimum.

The greater the in-process inventory the greater the amount of the tied up working capital; the greater the working capital per unit of production the lower the number of production units which can be financed by a given amount of working capital; and it normally follows the lower the earning power of that given amount of working capital.

The in-process materials not only tie up working capital but also tie up working space, and in so far as the space they occupy is greater than the minimum required, the material in process usurps space

which is potentially productive. This is another way in which a too high in process inventory can have a direct adverse effect upon the earning potential of a productive enterprise.

In the case of W. & L. E. Gurley, where most plant capacity is utilized for production of finished parts for inventories prior to assembly into finished goods, consideration must be given to the fact that the greater the inventory the greater the chances for depreciation, shrinkage and obsolescence. It is a common practice for inventories to be handled and accounted for in a much looser manner than would be condoned if company personnel were handling cash. This frequently results in loss of considerable working capital.

Controlling a company's inventory investment requires the application of concerted and coordinated effort to many phases of the company's activities, e.g., methods study to reduce the number of operations; standards study to reduce the number of varieties of items; process flow study to reduce the number of movements and storages; plant layout study to reduce the distances moved and the length of storages; production scheduling to manufacture the quantity required for sales as close to the sales potential as is economically feasible and to reduce the chances of depreciation; storeskeeping and inventory control to reduce the chances of shrinkage, losses and obsolescence; and of purchasing to reduce the number of handlings and amount of storage for raw materials.

Effect of seasonal peaks on inventories and investment. Because sales often fluctuate in cycles seasonally and is beyond the control of the Company, a paralleling of manufacturing and sales would

require provision of plant capacity and factory personnel to meet the greatest expected sales rate. At any other rate there would be idle capacity of machinery and personnel, and if the working force did not expand and contract with sales there would be idle personnel. To avoid the provision of varying capacity to meet sales peaks, production must be scheduled so as to provide finished goods inventories to meet sales peaks and to utilize nearly constantly the plant capacity. This will permit a minimum investment in fixed assets and will provide a maximum working capital.

In the case of W. & L. E. Gurley there is apparently considerable idle capacity for all foreseeable sales demands for engineering instruments. It is uneconomical to operate in this manner, and for this reason it is highly desirable, as recommended under the Sales part of this report, for a good market research to determine the amount of sales which can be expected so that productive facilities, plant layout, methods, standards, process flow, scheduling, etc. can be planned better to reduce not only the idle capacity investment but also the factory space requirement, so that W. & L. E. Gurley may better serve the purpose of stockholders, workers and consumers.

Effects of inventory turnover on profit. Of primary importance to a business is the making of a good return upon its investment.

"Profit earned by any business is affected to some degree by inventory turnover. Mr. W. M. Vermilye (of the National City Bank of New York) sets up a simple equation which shows the general relationship as follows:

Let W = working capital

T = turnover (the annual output divided by average inventory); then

WT = V (volume of business done in dollars).

If P = rate of gross profit per dollar per turnover, then

VP = total gross profit for the business.

If O = the overhead of the business and

P_n = net profit, then

$VP-O$ = P_n or substituting $WT = V$

$WTP-O$ = P_n.

An increase in net profit can be realized if this working capital is increased, if turnover is increased, if the rate of gross profit is increased, or if the amount of overhead is decreased. The gross profit must be very large in a business where the turnover can be only once per year or less in order to justify the use of working capital and the payment of ordinary overhead. The most important factor in this equation may be the inventory turnover factor T because it has more possibilities for improvement. Moreover it often benefits but seldom hampers production.

> 'Banks always press to have the inventories of their borrowing clients at the lowest possible point because so many losses have been due in the past to the failure of their clients resulting from a depreciation of inventory.' *

The banks prefer statements which show slow-moving goods at a minimum. Large inventories of rapidly moving goods are the best security for bank loans because these can readily be turned to cash especially

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*W. M. Vermilye of the National City Bank of New York, "Economic Trends in Manufacturing and Sales", p. 18. Private printing.

when they are in the form of finished goods." *

The percent of return is dollars net profit divided by dollars invested. Since a large portion of the Company's investment, usually twenty-five to fifty percent of its capitalized value is in inventories, the effect of inventories on profit and the value of frequent turnover can readily be appreciated. Furthermore the inventory investment element is the investment element most responsive to control; consequently controlling the inventory, controls to a large degree the percent of return on the investment.

Inventory turnover rate. The unit of inventory budget measurement is turnover. Turnover is expressed as the ratio of the value of the inventory used in making the yearly output (sales) to the average yearly investment in inventories. The historical turnover rate of a business may be ascertained by plotting a series of yearly inventory output dollars as the abscissa versus average yearly investment dollars in inventories as the ordinate. To determine the average turnover rate draw a straight line through these several points by either inspection or the methods of least squares and determine its slope. The slope of this line, its tangent, is the average turnover rate. For example see Figure VII-1. The deviations should be appraised. In cases where there is not sufficient reason for the operation of other than chance cause systems, they should be statistically evaluated to determine if past performance is in control

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*Charles A. Koepke, Plant Production Control, 1st ed., John Wiley & Sons, Inc., New York 1947, p. 182.

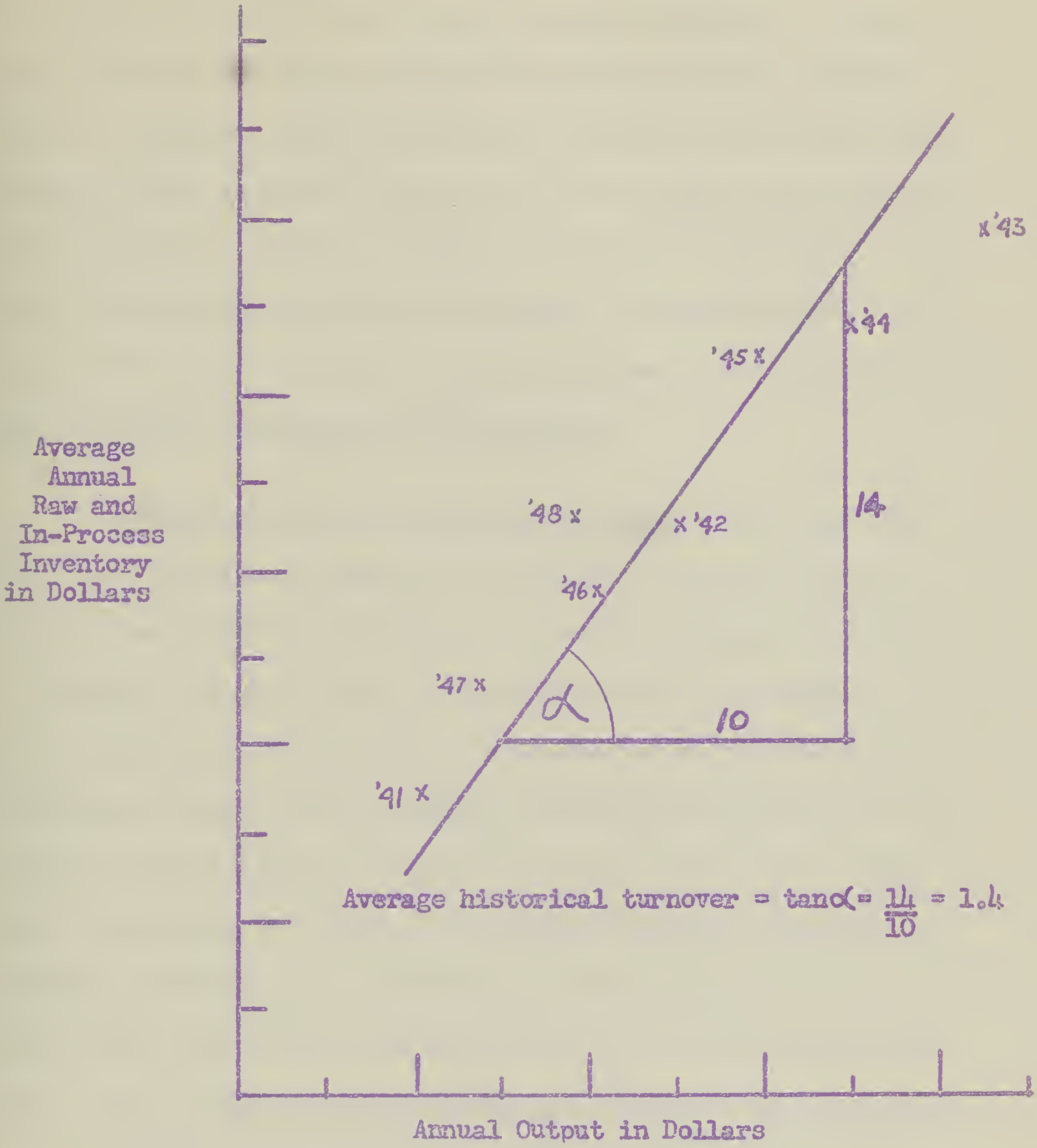

Figure VII-1 Historical plot of annual (inventory) output in dollars versus average annual raw and in-process inventory in dollars to permit determination of average historical turnover. The average historical turnover rate is the slope of the median line.

This method is simple and its quickly gives a yardstick to compare present and future with the past.

with respect to its even undefined empirical standards. If these points should be in control and still the turnover rate does not produce the desired return upon capital invested, then either basic inventory policy should be changed or reasons other than inventory problems should be sought to explain the Company's difficulty. For a more complete and provocative discussion of turnover see Mr. H. F. Dickie's "Six Steps to Better Inventory Management" in the August 1953 issue of Factory Management and Maintenance.

Primary purposes of inventory planning. The production function of inventory planning is to maintain a proper balance of available raw materials and parts so as not to endanger production. The financial function, which is in conflict with the foregoing, is that of maintaining inventories at a minimum consistent with sales requirements, manufacturing programs and company policies so as to obtain an optimum number of turnovers per year and so as to avoid tying up large sums of capital. The normal tendency of production management executives is to manufacture large quantities so as to reduce set-up times and to pro-rate their cost to a large number of items. This, however, ties up capital and overtaxes storage facilities. Effective inventory planning requires attention to inventory levels, investment and turnover, and the integration of Company policies, sales forecasts and production scheduling, as well as the purchasing program.

Zoning valuation of parts. As all raw materials and parts in store do not have the same value, maximum economies can be effected by directing attention to those stores which have the maximum

value. Several studies of valuation of parts in other companies show that a small percentage of parts account for a large percentage of inventory valuation, and conversely that a large percentage of parts accounts for a small percentage of inventory valuation. Between these two extremes lies a zone of parts of intermediate monetary importance. A graph of percentage of parts for such companies versus percentage of inventory valuation would look somewhat like Figure VII-2.

Figure VII-2 indicates that maximum economy of effort, maximum reduction in inventory and increased turnover can be obtained for the least amount of controlling if attention is first applied to those zone "A" items. It further indicates that least attention should be shown to those items plotted in zone "C". To make such an analysis of valuation of parts requires (1) extending value of each piece times the normal inventory level (valuation to include material, labor and overhead, or purchased price of purchased finished parts), (2) arranging items in descending order of total inventory value, (3) accumulating the numbers and cost of the items, (4) converting accumulated numbers and costs into percentage of total, and (5) the plotting of a chart like the one shown in Figure VII-2.

An analysis of this kind indicates that greater attention of all kinds should be applied to zone "A" items; for example (1) to reduce intrinsic value, conduct engineering methods studies on zone "A" items, and (2) to reduce inventory valuation, maintain tighter shop schedules, prompter flow through the plant, more accurate estimate of requirements and lower protective stocks of zone "A" items. As quantities and intrinsic values are reduced items will shift in

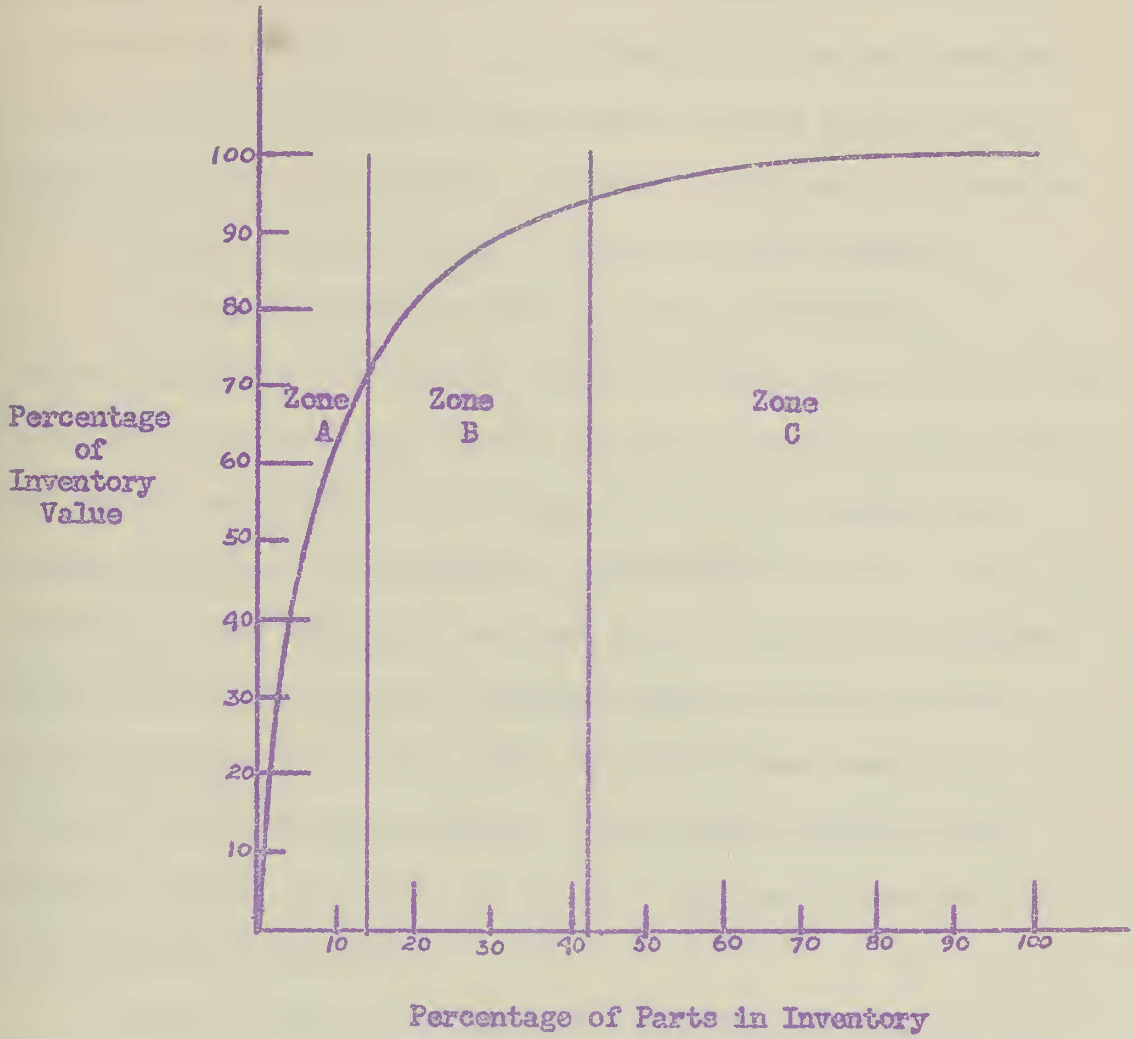

Figure VII-2 Theoretical plot of percentage of parts in inventory versus percentage of inventory value.

relative positions so that items of zone "A" may now become zone "B" or zone "C" items, and those items previously of less importance may now become quite significant; consequently periodic re-appraisal of item-valuation versus inventory- valuation is necessary if attention is to be focused continuously on the area of maximum benefits.

As zone "C" items account for a small percentage of inventory valuation, substantial protective inventories of these items can be carried without large adverse economical effects. When better usage data is available, this fact permits further economies in inventory processes if the system of "bin reserve" is used. "Bin reserve" is a term applied to the technique of separately packaging minimum stock and issuing the remaining material without detailed recording of each issue. The amount of time between receipt of previous new shipment and opening of "bin reserve" and the usage during this period, indicate average usage that may be recorded and used for planning purposes.

Major pitfalls that might be encountered in using the above system result from the same kind of things that occur in any system, i.e., belief that the system can do management's planning and decision-making. As conditions change significantly, new studies must be made. For example, a new machine or change in design might make it possible to manufacture a certain "A" zone item in much less time - maybe even as needed. Such a change would obviously require reappraisal just the same as would the reverse case where it is now harder to procure or manufacture the item. Also, sealed "bin reserve" of zone "C" items should be appraised periodically in the light of changing conditions.

If procurement or manufacture times should be increased, there would now be a tendency to run out of stock, but if these times decrease, there is a cost of carrying excessive protective stock that can be eliminated.

Economic lot quantities, general. Having discussed the importance of inventory turnover and a way to focus attention on those items of major valuation importance, let us look at a method of effecting further economies. That of determining optimum or economic lot quantities for each part or material. Inventory carrying charges vary directly with respect to the quantity of parts carried and may be represented graphically as the straight line designated as "Carrying Charges" in Figure VII-3. As cost of acquisition of parts normally decreases curvilinearly as quantity increases and approaches asymptotically some low value, it may be represented by the curved line designated as "Cost of Acquisition" in Figure VII-3. The total cost of inventory for any one part or component is the summation of the curve values for "carrying charges" and "cost of acquisition". A plot of quantity versus unit inventory cost of part or material is represented by the upper curve in the figure. The minimum point on the upper arc marked "Economic lot" is the most economic lot quantity to purchase or to manufacture. Consideration of several alternative calculations and choices will be required since discounts can be realized by placing a large lump sum order of many different raw material items of same material content. Fox example, brass rods of varying size. The effects of this saving must be considered not only in determining economic lot quantities of raw material but also in determining

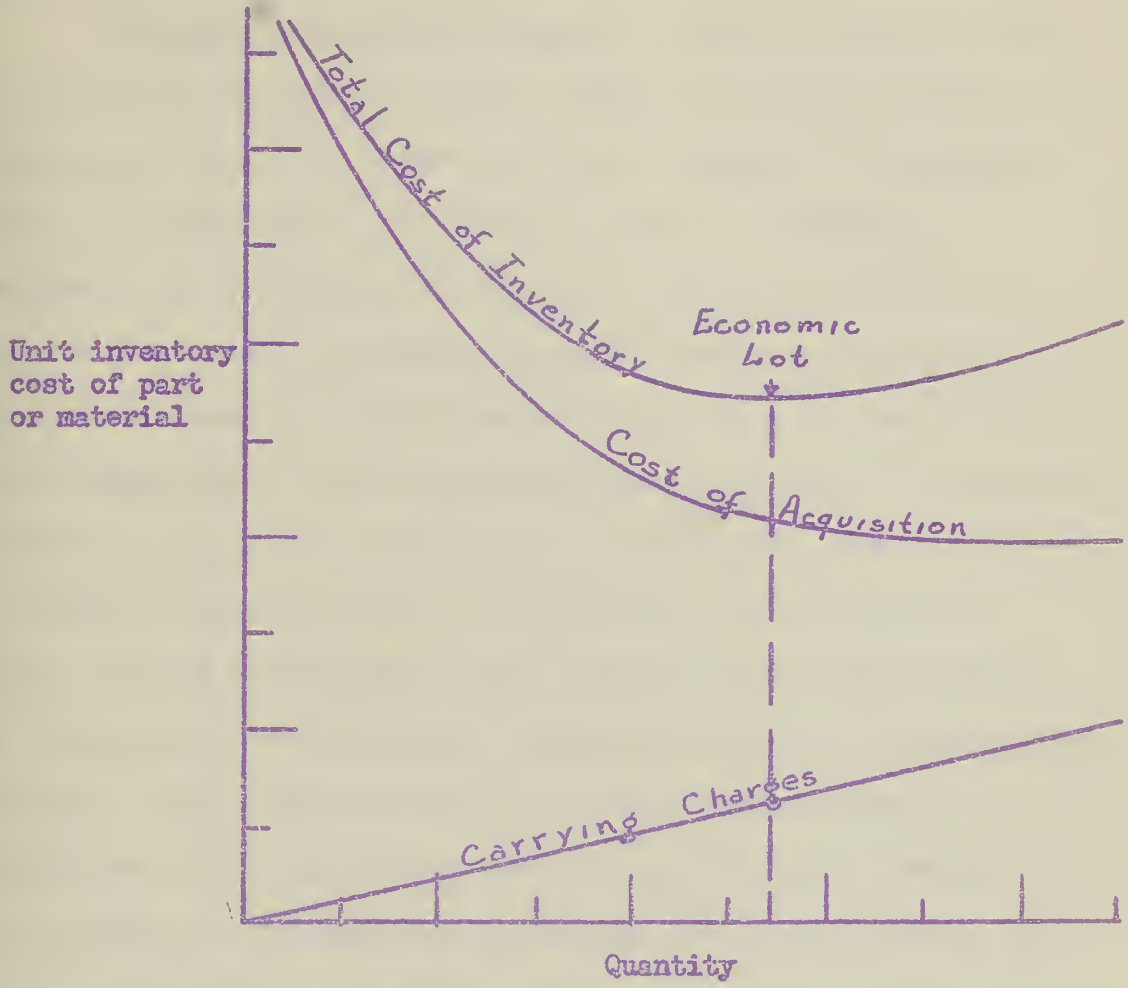

Figure VII-3   Theoretical plot of Quantity versus Unit Inventory Cost of Part or Material.

economic lot quantities of finished parts.

Economic lot quantity formulae. A number of formulae which may be found in production handbooks, texts and current literature on production and inventory control have been developed for determining economic lot quantities. Fox example, we have (a) Younger and Geschlem's, (b) Lehoczky's, (c) Camp's, (d) Norton's, (e) Davis', (f) Patjen's three cases, (g) Raymond's and (h) Operation Research's. All of these formulae establish relationships among the various factors such as usage rates, value of part, preparation charges per lot, value of finished part, cost of storage per piece per year, carrying charges for average inventory, danger of obsolescence, desired return on capital invested in inventory, usage rate during procurement period, and, when parts are manufactured, manufacturing capacity, manufacturing time, etc. These formulae yield precise figures for economic lot size, standard order quantity and the like, but caution must be exercised as their answers are the result of assumptions such as usage rates, carrying charges for average inventory, cost of storage per piece per year, etc. Their results can be no more accurate than the assumptions and the figures based upon the assumptions that are substituted into the formulae.

The economic lot quantity formulae are not universally applicable, but must be derived from the facts in each given situation. For example, see the discussion of purchase of raw brass rod materials discussed under Findings. In this case the purchasing economic lot quantity would have to be based upon a summation of several small requisitions accumulated in a stipulated short period of time. In

fact, to realize maximum savings through the larger percentage price reduction on bulk orders, a review must be made not only of all brass bar stock cards but also of all finished stock items that are manufactured from brass bar stock. Those items that are so near their ordering point that they will be required in the immediate future must be lumped together and a single large bulk order be placed for this quantity. Not only does the system make possible a greater price reduction but also it reduces the number of orders placed and their attendant work requirements.

The results of the several formulae are not the same; but, as may be seen in Figure VII-3, the curve is nearly flat and constant over a wide range, and most of the formulae give solutions that fall within the flat portion of the curve. Because of the "flatness" of the curve the "economic lot quantity" may fall between plus and minus twenty-five percent (± 25%) of the optimum value with but little effect upon the unit cost of the item; however, the total inventory investment will vary accordingly. It must be remembered that the results of the formulae are apt to be very inaccurate when conditions change suddenly. Because the "economic lot quantity" is a function of so many complex variables, with some of the variable values being as hard to obtain as the desired answer, computations are tedious and costly and are a serious stumbling block where thousands of parts are involved.

It might perhaps be useful, however, to use a simplified version and calculate economic lot quantities for those high-valued zone "A" items. A formula frequently used for computing the economic quantity is:

$$Q = \sqrt{\frac{2PR}{CI}}$$

where: Q = economic lot quantity in units.

P = preparation cost per lot in dollars, consisting of clerical cost of preparing the order as well as set-up and dismantling costs.

R = requirements in units on an annual basis.

C = cost of part in dollars per unit.

I = carrying charge for average inventory in percentage per year (expressed as a decimal) including insurance, risk of damage, obsolescence, spoilage, etc. (Ordinarily at least 15% and might easily be as much as 25%).

Economic lot quantity nomograph. By use of graphical analysis nomographs may be prepared to permit ready solution of "economic lot quantities". One such graph adapted from page 182 of PRODUCTION CONTROL by Franklin G. Moore is reproduced in Figure VII-4. It is to be noted that the equation plotted is the simplified version of the formula discussed above when $I = 25\% = 0.25$.

ECONOMIC LOT [illegible]

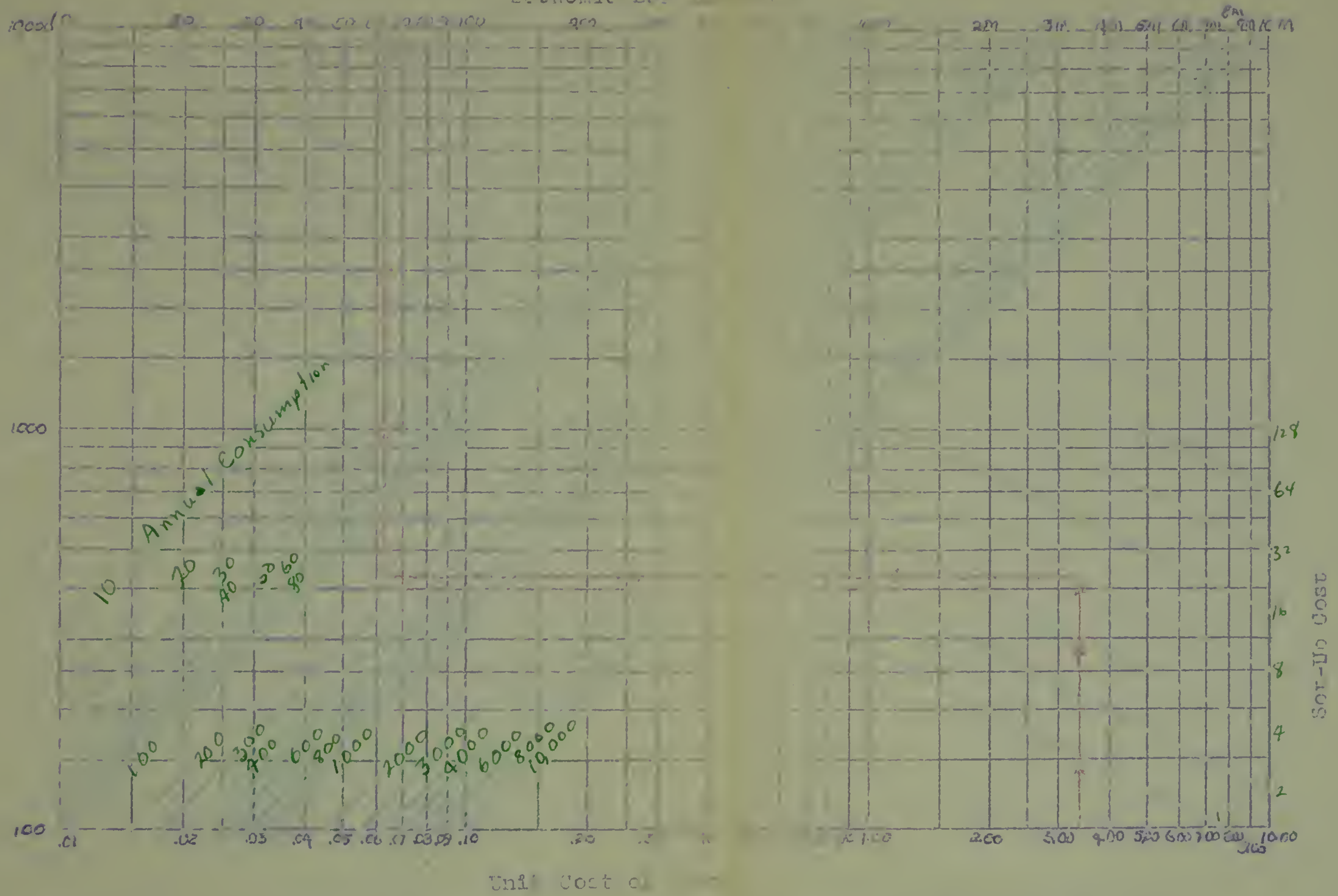

Figure VII-4 Families of curves plotted t[illegible] [illegible]omic lot quantities without further calculation. To fi[illegible] [illegible] lot, locate the unit cost on the unit cost scale, say [illegible] vertically upward to the intersection with the proper [illegible] [illegible], say 8.00, project horizontally across to the i[illegible] [illegible]h the appropriate annual consumption line, say 200, [illegible] [illegible]ward and read the economic lot size on the top scale. [illegible] the economic lot quantity is 62.

Some companies hesitate to use these economic lot quantities formulae and nomographs because of:

1) complexity of formulae
2) assumptions of values substituted therein
3) the "flatness" of the curve in the area of the "economic lot quantities"
4) the fact that the economic lot quantities have only transitory validity because of changes occurring in demand, cost and other factors
5) the fact that general operational policies play an important part in actual manufactured lot size; as, for example, (a) larger lots may be produced during temporary slack periods; (b) in case of an unfavorable company economic condition smaller lots than economic lot quantities may have to be manufactured; (c) present and future price trends influence lot size.

Other systems of determining lot quantities. Other companies, however, have found these formulae most useful in conjunction with the experience and judgment of management personnel who are fortified with forecast knowledge, scheduling data, purchasing data and other management data.

Another good system used by still other companies embodies inventory clerks submitting a data card to the planning manager showing: part or material, purchase or manufacturing units, the using manufacturing division, final product, average month's consumption for previous year, units of shipment or manufacturing, time usually required for

shipment or manufacturing, available storage capacity, this year's weekly tabulation of amount of material on hand, amount used during the week, summation of usage for the year to date, amount received or manufactured during the week, and outstanding orders. The reviewing executive indicates the amount to order.

Advantages of lot quantity considerations. All of the above systems for determining economic lot quantities or lot quantities involve considerable clerical and/or computation work in addition to management decisions; but they have advantages not accrued from the present maximum-minimum approach in that: (1) they are not based solely on past experience; (2) they define minimum inventories in terms of order filling times, shipment delays, etc; and (3) they require management's periodic review to determine the status of current inventory limits. This last requirement is seldom the routine work of the manager to whom it is assigned; and, because of this, it is one that can be, and frequently is, neglected. It must be borne in mind, however, that no amount of inventory planning will ever take the place of an efficient market analysis and forecasting, even though it can supplement and complement these phases of good management.

Other inventory planning principles. Having discussed the broader phases of inventory planning, let us now turn our attention to other important considerations. For a system to be appropriate for any company, its management personnel must either design or participate in the design of its own system or adapt another system to its particular needs.

For any system to be effective the system itself must be

known to all persons having responsibilities for its operation. It must be accepted and respected by those persons; it must provide controls which will permit appraisal evaluation; it must provide methods for handling all routine problems; it must provide ways to handle non-routine problems; and it must serve the purposes of management. The best system is the simplest possible that meets the above requirements and does not restrict management's opportunity to exercise judgment. Inventory planning should also embody the following principles:

1) All forms and paperwork systems used to record and distribute information such as items requisitioned, allocated, disbursed or received should be so designed as to expedite clerical work and to involve a minimum of waste motion in making entries thereon and in distribution.
2) Inventory records must be reduced to a minimum number, and the method of filing the records must be systematic and such as to promote a maximum motion economy during the process of finding a particular record, making necessary entries thereon, and/or referring thereto for information regarding an item of inventory. The inventory card, or any other form, should not resemble an attic full of junk which no one can bear to part with because "it might come in handy someday", but at the same time all necessary data must be available for reference and use when needed.
3) Whenever determinable, the ordering quantity, ordering level, expediting level and maximum quantity must be recorded on the inventory records. These terms may be defined as follows:

Ordering quantity, when conditions are normal, is that economic lot quantity determined as previously discussed.

Ordering level (Ordering Point) is the lowest level at which necessary reserve quantities of material can be provided plus whichever is smaller, the maximum usage during the expected procurement or manufacturing period, or the maximum usage during the average period between issuance of replacement orders.

Expediting level (or F. U. Level) is the lowest level at which the initiation of expediting action will result in receipt of sufficient material or parts to continue operations without undue adverse economic effects, even if maximum rate of usage is experienced.

Maximum quantity is the economic lot quantity plus the maximum possible quantity on hand on receipt of the economic lot quantity.

4) All pertinent data regarding each item of recorded inventory must be posted on inventory records. Such data would normally include:

   a) Description and identification of the material, part or assembly to be maintained in stock;

   b) Stores location;

   c) Data regarding each requisition issued, e.g., date of order, purchase or manufacturing order number, supplier and quantity ordered, and if not kept in requisition files elsewhere, the date requested or required;

d) Data regarding each quantity of inventory received, such as date received, purchase or manufacturing order number, and quantity;

e) Data regarding each quantity of inventory allocated to in-process work or contemplated work, such as date allocated, date required, manufacturing order number, and quantity;

f) Data regarding each quantity of inventory which is still available for use or allocation as a consequence of each receipt, issue or allocation of material;

g) Standard levels of inventory for control purposes, such as expediting or follow-up point, maximum quantity, order point, and order quantity;

h) The unit cost of manufacture or purchase, preferably a standard cost;

i) Principal uses of the item;

j) Reference to production schedules where scheduling several parts using same basic raw materials or machine set-ups or operations will effect economies;

k) Cumulative usage figures to permit ready estimate of average usage and rate of usage; and

l) Mechanical checks on posting errors.

5) The balance of each item of inventory available for use must be known at all times.

6) Whenever increases in the balance of inventory exceeds to a significant degree the maximum quantity, the fact must be

immediately reported to cognizant inventory planning personnel, and, in cases where the maximum quantity is repeatedly so exceeded, planning personnel must promptly and effectively act to determine the cause and to prevent the continuance of such excess inventories. The causes of such excess inventories may be:

a) A decrease in the average rate of usage

b) A decrease in the average period of procurement or manufacturing.

c) A decrease in the maximum rate of usage; which causes the Order Point to become too high.

d) A rate of usage during procurement or manufacturing less than the expected minimum.

e) Errors in posting receipts, issues and/or allocations to the inventory records.

7) Inventory records must provide ways to handle both routine and non-routine problems. The mass of the above data is required so that this principle can be satisfied.

8) Inventory records must provide necessary data and guide lines so that records may be appraised and evaluated in terms of defined controls. This can be accomplished if the above principles are embodied in the records.

9) Inventory planning should provide a way of bringing periodically to the attention of management personnel a summarized report of slow-moving, obsolete and damaged parts or materials.

10) Inventory planning should embody an inventorying system which may be either a combination of or a straight application of any of the following systems:

    a) Shutting down the plant periodically and taking a complete physical inventory.

    b) Take inventory of each item as it reaches the minimum. Special provisions must be made for inventorying those items which do not reach a minimum level during a specified period.

    c) Progressive count method of checking inventory records with quantities of a certain number of items periodically so that a complete inventory is made within a given interval of a few months.

11) Inventory classification may be desirable. It can be accomplished in a number of ways. One system is according to position in manufacturing sequence, namely (i) raw materials and/or purchased parts; (ii) work in-process; (iii) finished parts inventory and (iv) completed units of inventories.

12) A reiteration, but a very important principle of management is that all personnel involved in the functioning of an inventory system must clearly understand their individual functions and responsibilities, and their relationship to all other complementary functions necessary to achieve effective inventory control.

Proposed Inventory Record and Data Card. In the case of W. & L. E. Gurley inventory procedures, policies, systems, methods and operations change frequently because controls do not exist or are not exercised and because adequate information for proper planning and control is not available. The obtaining of adequate information for planning requires systematic accumulation of pertinent data. The vehicles for this systematic accumulation of all pertinent data are non-existent, but if W. & L. E. Gurley's management personnel would consider an inventory card as shown in Figure VII-5, a system could be devised so that data previously not shown would be available. By preparing the permanent record section on a separate card, a resumo of long historical data would be available for review and evaluation. With such information as could then be accumulated and by the use of principles discussed, a more scientific inventory planning and control system could be devised.

Advantages of proposed Inventory Record and Data Card. By the use of the form in Figure VII-5 annual material requirements could be readily reviewed and tabulated. Comparison of inventory records of available materials with sales forecast requirements (determined by summing the extended quantities used per instrument as shown on the permanent record card times the sales forecast quantity of each instrument) would give the quantities required to be manufactured to meet the sales forecast. The manner in which this differs from the present system is that the work sheets of annual requirements for all parts would no longer have to be prepared manually by the Planning and Control Manager. Under this system only those parts that must be

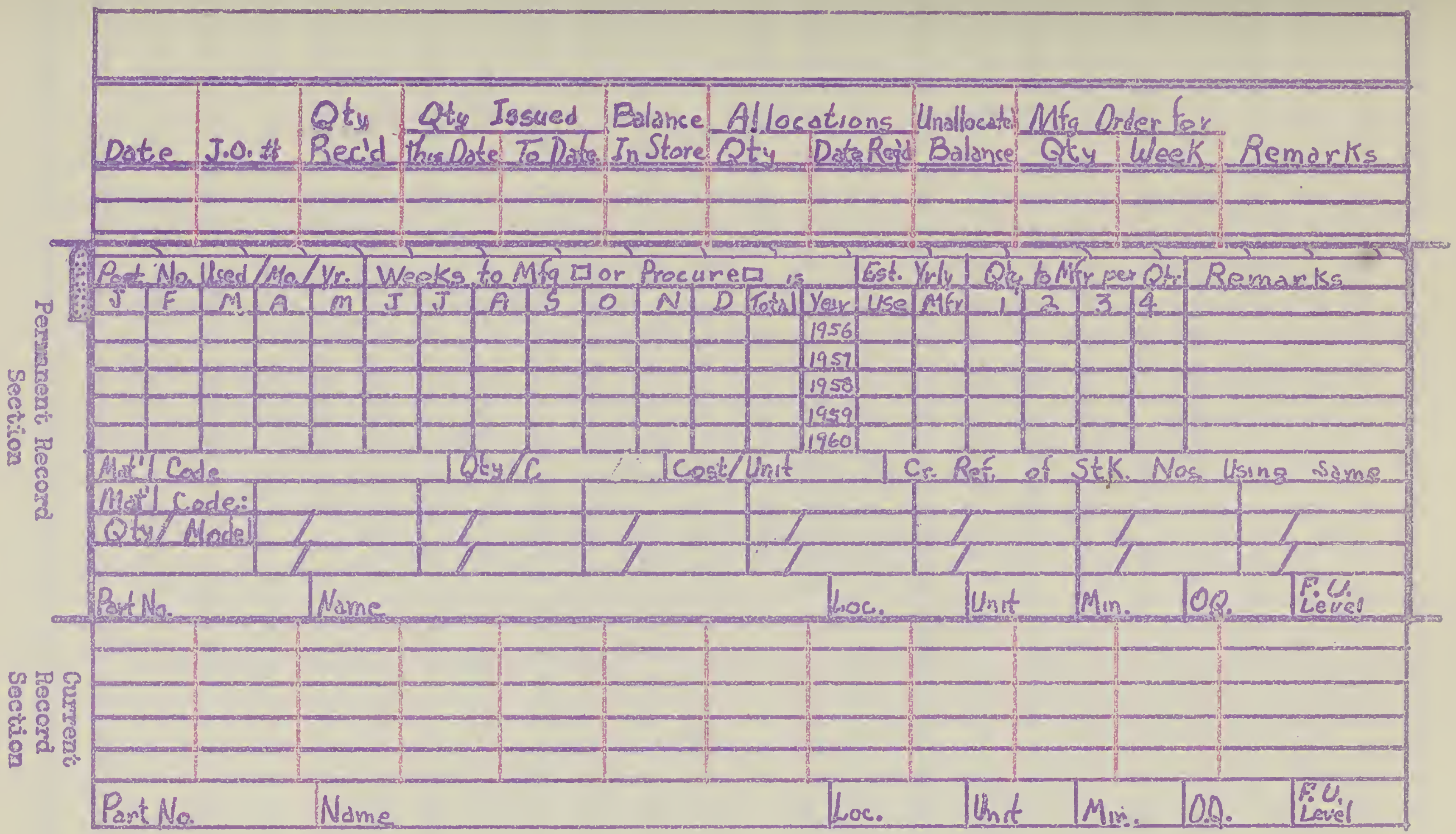

Figure VII-5 Inventory Record and Data Card proposed for consideration. The Permanent Record Section can be either inserted so as to overlay the bottom portion of the Current Record Section or hooked over its top. In this manner the full working space of the Current Record Section can be used.

manufactured this year need be recorded. Such recording should show part number, quantity and date on which manufacture should commence and be completed. These dates would be determined from the inventory record card date, "Weeks to Mfg. ☐ or Procure ☐ is .", and by estimating from the quantity on hand the date on which the minimum quantity would be reached. Perhaps it would be wise during these individual part reviews to annotate the allocation column of the inventory record with estimated quantities and required dates. Then as materials are used a comparison of issue data with allocation date would reveal the degree of variation between planned performance and actual performance. In cases of significant deviation, inventory control personnel should notify the Planning and Control Manager so corrective planning action could be taken.

When purchases are necessary a review of those inventory cards listed under "Cr.Ref.Stk. of No. using same Mat'l. Code: . . ." section of the inventory cards and all Raw Material Stock Cards of similar items will reveal full requirements for a bulk order prior to issuing a requisition. This would not only reduce the number of requisitions and purchase orders issued and receipts and handling of materials, but also would permit realization of maximum discounts on larger order. That is, when many types of raw materials can be "massed" together in an order to increase purchase discounts, all of these types of materials and the finished stock manufactured therefrom should be reviewed concurrently and prior to the placement of an order. A separate cross-reference of these stock numbers would be advisable so that maximum economies of motion and money aforementioned

could be realized.

Other specific points to consider and their advantages.

To permit more accurate planning, annual inventories should be made prior to review of next year's annual forecasts so that inventory records would have been adjusted to reflect accurate counts.

A uniform system of making issues is almost a necessity for accurate inventory records. It can be seen from Findings that the present system is not too conducive to accuracy.

A redesign of the job order book, discussed under Production Scheduling, would reduce from five or more stampings of address-o-graph plate to a single stamping per job order, and would eliminate the requirements of duplicative logging of job orders for the manufacture of replacement inventory items.

The location of some inventory record cards in the Production Planning Office is an example of management forethought since the records must be used continuously by the Planning and Control personnel. As relocation of all inventory record cards to the planning office would greatly facilitate production planning, due consideration should be given to this point. Further economies may be effected by relocation of inventory records and address-o-graph plates nearer the inventory clerk so as to reduce the amount of walking required to prepare a job order and to record inventory transactions from more than twenty feet per transaction to the point where these operations could be performed from a normal sitting position. As this would mean more time available the present incumbent could not only relieve the Planning and Control Manager of clerical duties now performed, but also he could apply more

attention to production schedule details such as referencing inventory records prior to issuing job orders.

Recommendations

The following recommendations are submitted:

1) State in writing the duties, responsibilities and functions of the various inventory personnel.
2) Define in writing a scheduled long-range inventory planning program.
3) In the execution of this scheduled long-range program embody the above discussed ideas and principles into a written inventory system with procedures, methods and operations to provide controls and guide lines.
4) Concurrent with the above do some fundamental research to determine the optimum turnover for W. & L. E. Gurley's business by elements of the business. The fundamental research should include investigation of the advisability of determing optimum turnover for the elements of inventory, i.e., raw materials, work-in-process and finished instruments and products.

INVENTORY CONTROL

Inventory control as discussed herein consists of continually comparing actual performance with the standards established by inventory planning, and either frequently adjusting performance in an effort to conform to those standards, or of notifying responsible inventory planning personnel.

Findings

Inventory control is exercised in varying degrees by the several foremen, clerks, the reticle engineer, purchasing department, and the Planning and Control Manager. The Planning and Control Manager is responsible for controls to be used for finished parts, except the optical and woodworking components, for transits, levels, alidades and industrial testing equipment. Raw materials for these instruments are controlled by two clerks working for the Planning and Control Manager. The Optical Shop Foreman sets control standards for optical parts. Control standards for the woodworking shop are physically set by the Carpenter Shop Foreman, but are maintained in a written form in the inventory journal as discussed in the Purchasing part of this report. The reticle engineer sets control standards for parts peculiar to photoprocessing and reticle work.

Minimums and ordering quantities for many items of raw materials are stipulated but are seldom used as they are unrealistic. Usually actual minimums and ordering quantities are determined by consultation with or consideration of the supervisors. In some cases ordered quantities of purchased materials are reduced in the procure-

ment process by higher management without consultation or consideration of the cognizant ordering management personnel. Receipts and issues are usually recorded. For raw materials these transactions are sometimes documented so that source and use may be traced, but in the case of finished parts this is never done.

Inventories are performed on an annual basis by a complete physical count of stock by personnel of the department or shop having cognizance of the stock.

Recently a list of raw stock items that have not moved for the past five years was submitted to the Planning and Control Manager. This list included approximately five hundred items, many in considerable quantities.

An inventory of parts for obsolete instruments is manufactured in lot quantities as need for the parts arises. The lot quantities are not based on part usage but are estimates of what might be needed in the future. Usually the direct cost of manufacture of these parts is charged to the repair job, but the charge of carrying this inventory must be borne by the overhead account.

Appraisals and Conclusions

Inventory planning standards are not accurately defined and recorded and are not clearly understood by all personnel concerned; hence comparison of actual performance with standards required for effective control is precluded. As recording of actual performance is not systematically done, an evaluation of controls is not possible. The decentalization of both inventory planning and controls to foremen

and engineers detracts from the effectiveness of these foremen and engineers in performance of their primary duties and adds confusion to the inventory planning and control picture.

It should be part of the systematic control procedure to review "dead items" and planning should provide some vehicle for disposing of such material.

The following principles must be incorporated in a good inventory control system:

1) Performance standards such as minimum economic lot quantities, etc. must be as accurate as possible.

2) These performance standards must be clearly understood by all personnel concerned.

3) Actual performance must be systematically recorded.

4) The method of recording actual performance must be such as to facilitate comparison of performance with appropriate standards.

5) Actual performance must be systematically compared with the appropriate performance standards.

6) Significant variations between actual performance and standard performance must be systematically recorded and promptly reported to planning personnel.

7) Control personnel must effectively act to eliminate the causes and effects of significant variations between actual performance or report these variations with apparent causes and effects to cognizant planning personnel for corrective action.

8) Physical inventories should normally be conducted by personnel other than those responsible for its storeskeeping and

record keeping.

Recommendations

The following recommendations are presented:

1) State in writing the various inventory personnel's duties, responsibilities and functions.
2) Present management personnel, using the above principles, devise a system specifically for W. & L. E. Gurley in which the following are defined in writing:
    a) the standards of performance
    b) the method of recording actual performance
    c) the manner of determining significant variations
    d) the actions that control personnel should take when significant deviations from standards occur.

Summary

In devising the aforementioned systems it would be well to bear in mind the following points which show the tie-in of inventory planning and control with purchasing, sales and production budgets, Company policy, etc. The following quotation is taken from the American Management Association's Management Review, February 1947:

> "The following is a management check list which might be utilized in making a quick appraisal of the effectiveness of your inventory control policy:
>
> 1. Are studies periodically made of inventory turnover?
> 2. Is the purchasing department given all essential data?
> 3. Are sales and production budgets prepared for the guidance of purchasing?

4. Are delays experienced within the purchasing department in expediting follow-up?
5. Are all purchase orders issued with scheduled 'wanted dates' specified?
6. Do all key executives know the company policy relating to inventory?
7. Is responsibility for the function of purchasing clearly defined and allocated?
8. Are competent and qualified personnel employed in the purchasing department?
9. Are policies regarding speculation, lot sizes, etc. periodically reviewed?
10. Is there a special procedure provided for emergency buying?
11. Is a perpetual record kept to reflect the current inventory status?
12. Are written reports regularly made on specific inventory matters, for example, standardization?" *

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* "Your Inventory Control System" by Keith W. Kingsland and Ray Marien in AMA's The Management Review, February 1947, p. 92.

PART VIII

STORESKEEPING

Storeskeeping is a service to the manufacturing departments. The primary objective of the stores section should be to contribute economy and facility to production. The functions of the stores section include:

1) Receiving and putting away for safekeeping all stock items.
2) Issuing materials and supplies to honor authorized requisitions.
3) Maintaining necessary storeroom records.
4) Controlling materials manufactured for stock to be used in further production.

Findings

The control of storeskeeping for the raw stockroom and finished parts stockroom is a responsibility of the Planning and Control Manager. One stockroom attendant is employed in the finished parts stockroom and two attendants are assigned duties in the raw material stockroom.

In addition to the raw material and finished stockrooms the function of storeskeeping is practiced and recognized in three other departments. The responsibility of storeskeeping in these departments rests with the person in charge. Unrecognized storeskeeping is also practiced in shops by foremen, without the attendant responsibilities. Batches of parts sometime remain in operating departments for a period of weeks before the initial productive operation is performed.

The methods of storeskeeping control established for the raw material and finished stockrooms follow accepted principles. However, these principles are not always adhered to. Workers have access to the stockrooms and frequently enter the finished stockroom and pick up one or more items without bothering to present a requisition. Varying degrees of control exist in the other departments which perform recognized storeskeeping. One department does not maintain any formal records of receipts and issues of materials.

Physical inventories are conducted annually. However, due to the pricing methods used, this inventory does not present an accurate picture of material on hand.

Periodic bin checks are not made. Random checks of inventory cards revealed inaccuracies in the maintenance of these cards. Actual counts and quantities shown on the records did not agree.

Adequate space for stores is available. Stalls and bins in the finished stockroom are identified by a numerical system.

Appraisal and Conclusions

The storeskeeping system in operation at W. & L. E. Gurley may possibly contribute facility to manufacturing departments, but it does not contribute economy to the operating departments or to the Company. The decentralization of control cannot result in efficiency of operations. The physical decentralization of the stores may be justified in some instances, but decentralization of control in an organization of this size would be difficult to justify.

In the organization plan it is felt that storeskeeping should be a responsibility under the planning department. However, some organizations place this responsibility under the manufacturing or purchasing department.

The location of the planning department within the finished stockroom is undesirable. Persons entering the room for planning consultations interrupt, and are interrupted by, the normal stockroom functions.

Although storeroom equipment is at a minimum, some items of equipment on hand are not used advantageously. Weighing scales are available in the finished stockroom but an attendant laboriously counts a hundred small screws and packages them for issue.

Due to the acute need for an adequate system for controlling materials, such items as storeroom equipment, layout of storage areas, transportation, and methods of storage are thought to be refinements to be studied and considered as long-range plans. It is believed that a sound control system could be installed and operated at no additional expense to the Company and that such a system would result in substantial savings to the Company. It has been said that two days of lax operations could wreck any control system. This should be borne in mind by those responsible for operating the storeskeeping system.

Recommendations

The following recommendations are offered:

1) That control of storeskeeping be centralized as a responsibility under the Planning Department.

2) That a study be conducted to determine what physical decentralization, if any, is needed in the storeskeeping functions.

3) That stockroom attendants be thoroughly indoctrinated in records-keeping in accordance with the inventory control system used, and induced to follow the system scrupulously.

4) That the Planning Department be physically separated from the finished parts stockroom.

5) That all persons, except attendants, be denied access to the stores.

6) That bin checks be performed, in a random manner, periodically in order to check the actual amounts on hand against the recorded amounts.

7) That materials not be issued unless an authorized requisition or scrap ticket is presented.

8) That materials not be delivered to the operating departments until these materials are actually needed to begin a job.

9) That issues of small screws and like items be made by weight rather than by actual count.

PART IX

COST ACCOUNTING

With the exception of general comments on the organization of the Accounting Department, this section is devoted to discussions and recommendations with regard to certain limited areas. Unusual satisfactory features as well as areas where it is believed that revisions of the accounting system should be considered are discussed. Modifications are recommended where it is considered that current methods result in management being supplied with distorted, inadequate, overly complicated or unnecessary information for conduct of the business.

Findings

Organization. The Head of the Accounting Department is responsible to the Executive Vice President and Treasurer, but has considerable direct contact with the President of the Company with regard to periodic and special financial reports. The Head of the Accounting Department also serves as Office Manager of the office performing the accounting, payroll and purchasing functions and in addition is Credit Manager for the Company.

The same person serves as secretary to the Head of the Accounting Department and performs the clerical work of the Purchasing Department. Despite the divided responsibility this arrangement has apparently been quite satisfactory.

Other personnel in the Accounting Department are one cost accountant, who serves as assistant to the head of the department, one

bookkeeper and three cost and payroll clerks.

In addition to the personnel in the Cost Accounting and Payroll Department there is a Cost Engineer who reports directly to the President of the Company.

No job descriptions are available, nor are lists of duties.

Cost Accounting. Significant features of the cost accounting system utilized by the W. & L. E. Gurley Company are as noted below:

a) Manufacturing Overhead. Manufacturing overhead is charged at the time of sale as a fixed percentage of the total direct labor cost of the job or instrument. This percentage may be adjusted during the year if it is considered that value of absorbed manufacturing overhead is significantly different from the value of the actual manufacturing overhead.

b) Job Sheets. Job sheets are maintained for all productive jobs, except those for repairs to instruments for which labor and material costs are maintained on small cards. All labor and material charges to the particular job are entered on its job sheet. Time values associated with the labor charges are also entered. At the time a job is started the following information is noted on the job sheet: job number, part number and name (if pertinent), and date job started. At the conclusion of the job the following information is added to the job sheet when pertinent to the job: total cost, type material used, number finished, number scrapped, time per hundred, labor cost per hundred, and material cost per hundred. Provision is made on the job sheet for entry of standard figures and the calculation of variances. Job sheets for completed jobs are routed via cognizant

department foremen to the plant manager. The job sheets are then returned to the Accounting Department where they are filed with the job booklet, material requisitions and scrap tickets for the job.

c) Labor and Material Charges. Except for some completed instruments, labor and material charges are obtained directly from job sheets or individual job cards for repairs to instruments). Obtaining labor and material charges for completed instruments is complicated by the fact that separate jobs are issued for the manufacture of lots of each of the individual parts and in addition jobs are issued for assembly of sub-components and completed instruments from these finished parts. Only those labor charges and material charges (if any) directly related to the actual assembly work are entered on the job sheets for assembly jobs. Information regarding the issue of parts for assembly jobs is not received or utilized by the Accounting Department. The following method of determining material and labor charges for complete instruments is used: (i) whenever a job for finished parts is completed labor and material costs per hundred piecesare entered on a yellow cost card pertinent to the particular part. This serves as a record of the unit cost of manufacture for each of the past few jobs for that part; (ii) for each assembly or sub-assembly a salmon card is maintained which indicates the labor and material costs per hundred for each of the parts in the assembly or sub-assembly. These cards are revised periodically so that the costs listed will represent the costs of the latest jobs for the individual parts. (iii) For each assembly a yellow card is also maintained which has labor charges and material charges (if any) listed for the various jobs for the actual assembly work.

The sum of charges on the two cards for a given assembly represents the direct labor and direct material charges for the calculation of cost of sales.

d) Finished Goods and Work In Process. All finished goods and work in process, including repairs to instruments, are carried in the same account. This account is adjusted monthly by debiting the productive labor portion of the payroll and the total of the raw materials issued for productive work during the month. At the end of each year this account is adjusted to the inventory evaluation of the sum of: (i) work in process (labor and material) from job sheets, for all uncompleted productive jobs except assembly jobs (see iv below); (ii) finished parts in storeroom, priced on basis of last job for part; (iii) finished parts being assembled into instruments. The value of finished parts issued for assembly jobs is not recorded in the Accounting Department; therefore in order to determine the value at a given time an inventory is necessary. These parts are priced on the basis of the last job for the manufacture of a given part; (iv) work in process (labor only) from job sheets for the assembly of instruments from finished parts. Labor and material charges for the actual manufacture of the parts were transferred to the Finished Goods and Work in Process account at time of manufacture and these charges do not appear on individual job sheets for the assembly of instruments from finished parts; (v) Completed instruments in stock; priced as explained in the preceding subparagraph.

e) Scrapped Parts. Whenever parts are damaged or ruined during process of manufacture, the material is turned in to be used in the manufacture of smaller parts or to be sold as scrap. A scrap ticket is prepared and sent to the Accounting Department. When the job is finished, the total number of parts scrapped during the process of the job is noted on the job sheet. Since the unit cost of manufacture of a part equals the total cost of the job divided by the number of parts completed, the scrapping of parts results in a higher indicated unit cost and the presence or absence of a scrap ticket does not affect the calculation of the unit cost.

f) Refinishing. Any refinishing work, required because of poor workmanship or for other causes discovered after a job is closed out, is charged to a manufacturing expense account.

g) Maintenance. For each building, jobs are kept open and job sheets are maintained for the listing of building maintenance labor and material charges on a per building basis. Plumbing work is done by an outside firm and is charged to a separate manufacturing expense account. Plumbing charges are not broken down on a building or departmental basis. There are manufacturing expense accounts for labor and material expended on machine maintenance. However, machine maintenance costs are not broken down on a machine or departmental basis. In general any electrical work on a machine is considered electrical building maintenance work rather than machine maintenance.

h) Research. Any research work related to the current line of products being manufactured by W. & L. E. Gurley is charged as an administrative expense. Any research devoted to improving the current

W. & L. E. Gurley products is considered a manufacturing expense.

i) Estimated Costs. No records of estimated costs for individual jobs or comparisons of estimated costs with actual costs are maintained in the Accounting Department. This is true of both repair estimates and estimates for jobs which the W. & L. E. Gurley Company has obtained by bids.

j) Spoiled Parts and Obsolete Material. Parts spoiled during assembly and obsolete materials are considered a period cost of sales charge. Obsolete material consists principally of those instruments accepted in trade-in which are not economically repairable because of age or for other reasons.

Cost Engineer. Utilizing data obtained principally from the Accounting Department the Cost Engineer prepares several records and reports. Among these are the Daily Report, Weekly Summary Report, Job Record, and Job Sheet.

a) Daily Report. The Daily Report is prepared in duplicate for each productive department and summarizes the productive work done in that particular department on the previous day. The following columns are included: name of part, identifying number of part, operation number from operation routing sheet, identifying number of machine upon which operation is performed, number of parts upon the indicated operation performed during the day (the letters SU in this column indicate that set-up time rather than production time is being reported for the operation), standard time per hundred pieces for the operation, standard time for the number of parts upon which the operation was per-

formed, the actual time expended on the operation during the day, ratio of standard to actual time, operator remarks, cost engineer remarks and foreman remarks. As a measure of the overall performance of each department each day the standard times are totalled and compared with the actual times (for those operations for which standards have been established). These totals and their ratio are listed as "measured performance". A total is also made of the actual times for those operations for which standards have not been established. This figure is listed as "unmeasured performance". The Daily Report is routed to the Plant Engineer (Assistant Plant Manager) via the cognizant department foreman. No indication of any time expended on other than productive jobs is made on the Daily Report.

b) Weekly Summary Report. The Cost Engineer prepares a Weekly Summary Report for each productive department. This report shows each day's "unmeasured time" (time expended in productive work for which standards have not been established), "measured time" (time expended in work for which standards have been established), and the total "standard time" for the amount of work done in the "measured time". Actual and standard times for jobs completed during the week are also listed. No indication of any time expended on other than productive jobs is made on the Weekly Summary Report.

c) Job Record. A form recently originated by the Cost Engineer is the Job Record. This form contains a summary by productive departments of the different job orders calling for the manufacture of a given part. Set-up time, operation times and material requirements are listed for individual job orders and average of last five job

orders, as well as standard. This job record is being made available to the Plant Engineer for guidance in the revision of standards.

d) Job Sheet. An additional form recently designed by the Cost Engineer is called a Job Sheet (not to be confused with job sheets maintained by the Accounting Department). One of these sheets is made out for each job order and affords a day-by-day and operation-by-operation record of the job. Standards are included for comparison with actual performance. This project is still in a preliminary stage and no definite routing of this form has been determined.

Financial Reports. A comparatively large number of reports are prepared by or with the assistance of the Accounting Department. Due to time limitation detailed analysis of all the various reports could not be made. Remarks made here about the various reports should be considered as impressions rather than verified facts.

a) Budget. A budget is prepared for each year's operation. The budget is based on the sales forecast, operating costs of the different departments for the previous year, trends, and so forth. Adjustments are made until it is considered that the most probable operating figures have been obtained. Difficulty in predicting the sales for the year has a great effect on the accuracy of the budget. There is no breakdown of fixed and variable elements.

If the preliminary budget does not appear to show a satisfactory profit, figures may be adjusted until it is considered that a reasonable profit is expected. It is believed that in some instances these adjustments have been on an arbitrary and/or percentage basis

with inadequate follow-up so that actual performance more nearly followed original estimate with obvious effect on profits.

b) Weekly Payroll Summary. Weekly, a payroll summary report is prepared which lists total payroll for each productive shop. These totals are also broken down into pay for productive and non-productive work within each of the productive shops. A breakdown of the payroll by expense accounts is also made. Total sales, orders and receipts for the week are indicated on this report. Various ratios of the dollar values on this report are included in the report.

c) Daily Report. A very detailed report is prepared each workday in the Accounting Department listing information pertinent to orders and sales of the various type instruments, accounts receivable, advance sales, cash, accounts payable and so forth.

d) Cash Estimate. Cash estimates are prepared in December and August on a monthly basis for a six-month period. These estimates are revised monthly.

e) Monthly Financial Report. A rather elaborate financial report is prepared each month. The following information is included in the report:

i) Trial Balance

ii) Balance Sheet

iii) Budget Control Form upon which actual and budgeted figures of sales, expenses and profits for the month and for the year to date are listed.

iv) A listing of orders, gross sales, discounts, net sales, gross costs and gross profit for months to date, previous year and current

year. All of this data is further broken down into the various categories of engineering instruments, repairs, resale items and miscellaneous items (industrial instruments).

v) A Profit and Loss Statement for months to date, previous year and current year as well as for the particular month of the current year and previous year.

vi) A listing of the various administrative, selling and manufacturing expense accounts showing both budgeted and actual figures for months to date of the current year and the current month.

vii) An analysis of Inventory Accounts report for months to date of current and previous year as well as for the particular month of the current and previous year. For the different inventory accounts (goods finished and in process, manufacturing materials and supplies, administrative and selling stores, and resale items) as well as for the total of these accounts, the balance at the beginning of the period, charges and credits during the period and the balance at the end of the period are indicated. The charges during the period against each of the accounts are also broken down into purchases, manufacturing expenditures, returned goods, royalties and miscellaneous. The credits to each of the accounts are broken down into cost of sales, administrative expense, selling expense, manufacturing expenditures and miscellaneous.

Appraisal and Conclusions

Work performed by the Cost Engineer and by the Accounting Department of W. & L. E. Gurley is apparently carefully and efficiently done. However, there are several basic weaknesses which limit the value and accuracy of information obtainable under the present accounting system. Most of these factors and their effects are interrelated; however, an effort will be made to discuss the factors and their principal effects one-by-one.

Job Descriptions. Although there seems to be a minimum of friction and uncertainty at the present time, the absence of job descriptions or of any sort of list of duties is a potential source of trouble.

Job descriptions and/or lists formally outlining duties and responsibilities should be prepared for the Cost Engineer and for all Accounting Department personnel.

Control and Determination of Costs. The method of distributing all factory burden on the basis of direct labor cost probably gives a distorted picture of the cost and therefore profitability of the various products and jobs. A disproportionate share of the cost of uneconomical machinery, scrapped and spoiled parts, space, power, heat, etc. is probably charged some products and jobs. Under the current accounting system it is not possible to determine the actual cost to the Company of operation of the various productive shops. Comparison of the shops is difficult and many inefficiencies are concealed.

In order to control costs, judge performance and to obtain a more accurate idea of the costs of the different instruments and jobs it is recommended that a standard cost system be established. If such

a system is installed too hurriedly, without proper organization or without proper support, the results are likely to be disappointing. On the other hand an adequate, properly organized and supervised standard cost system should afford a valuable tool for the improvement of the overall financial position of W. & L. E. Gurley. In addition to the reasons previously listed for the recommending of a standard cost system, accurate data should be more readily obtainable for such things as operating budgets, determination of prices of instruments, and a basis for competitive bidding. As an example, under the present system it is possible to obtain a reasonably good estimate of direct labor, material cost and desired profit as a basis for a competitive bid. However, the bid as made includes a provision for overhead which is arbitrary and unrealistic in that it represents the average rate for the overall Company rather than an equitable allocation. Jobs which on the "overall" basis appear to be unprofitable may be very desirable if performed in an efficient shop. Products which appear to be profitable may not be if the major portion of work performed on them is done in inefficient shops. In any event,other things being equal, it is better to take a job at a price which covers direct costs and provides some contribution toward fixed costs than to refuse such a job. No such analysis is made nor is an accurate one possible with the current accounting system.

With a standard cost system the responsibility for costs and for the control of costs for clearly defined areas, known as cost centers, is placed directly upon the supervisor of the area. The limits of cost centers should be clearly defined; cost centers should

not overlap and there should not be joint supervision of any operation by the heads of two cost centers. Expenses of non-productive cost centers must be redistributed (sold) to productive cost centers.

In W. & L. E. Gurley where it is not possible at present to set time standards by the use of time and motion study, it is recommended that time and material standards be set by an analyzation of past performance and of the individual operations. It is not recommended that past averages be used as standards since as a rule standards based on averages in a non-incentive plant are almost invariably loose. The present standards should not be accepted without a detailed review of each one. Standards as established should represent good attainable performance. The foreman who will be held responsible should be consulted in connection with the setting of standards.

The determination of logical cost center limits is affected by the organization structure of the Company. Although no detailed recommendations regarding cost centers are made, the organization structure as recommended within this report is an excellent basis for determining cost centers.

Much valuable information regarding standard cost systems is contained in the book, STANDARD COSTS FOR MANUFACTURING by Henrici. Another source of information is COST ACCOUNTING by Nickerson.

Finished Goods and Work In Process. Having all finished goods and work in process in the same account makes analysis of inventory or inventory carrying charges for the various products very

difficult. Analysis on the basis of data available for the end of 1954 indicates a relatively large inventory of instruments and parts with a very low inventory turnover rate for the year. With the single account for finished goods and work in process no information regarding issues of parts for individual assembly jobs is processed through the Accounting Department. This contributes toward a loss of control. Even if a standard cost system is not initiated for W. & L. E. Gurley, it is recommended that this account be broken down into accounts of (i) Work in Process and (ii) Finished Goods. Each of these accounts should be further broken down into (1) Engineering Instruments, (2) Industrial Instruments, (3) Reticle Jobs, and (4) Repairs. The Work In Process accounts for engineering instruments and industrial instruments would be more complicated than those for reticle jobs and repairs in that it would contain the inventory of finished parts as well as active jobs for fabrication of parts and jobs for the assembly of instruments.

Maintenance Records. The method of charging building and machinery maintenance as a manufacturing expense to be prorated to all jobs and products results a distortion of cost figures. The establishment of a standard cost system, as previously recommended, should tend to correct discrepancies in the allocation of maintenance costs insofar as individual departments are concerned. This should result in a more equitable distribution of these maintenance costs to the different products and jobs. However, the lack of any records as to maintenance costs of individual machines complicates any effort to determine uneconomic machines. Whether or not a standard cost system is established, it is recommended that records of maintenance charges for individual

machines be established. Both electrical and mechanical work on machines should be included in these records.

Cost Engineer Reports. The absence of standards in some areas and of good standards in other areas limits the value of reports prepared by the Cost Engineer. Disregarding the effect of standards, the current reports seem to supply a great deal of information relative to performance on various individual operations as well as on the overall performance of the different shops. It is believed that the daily report and weekly summary report prepared by the Cost Engineer would be strengthened by the inclusion of data relative to a comparison of total time to productive time for each shop.

It is recommended that a weekly or monthly report showing the performance of each operator be prepared for each productive shop. This report should show actual vs. standard times for all work done by each operator and should also include "unmeasured" work (work for which standards have not been established) and non-productive work. This report should be made available to the cognizant foremen and Plant Engineer, but probably should not be circulated at lower levels. Periodically each foreman would be expected to discuss the adequacy of performance with his individual workers. The value of this report would be directly dependent upon the accuracy of work standards.

Budget. The current budgets are of limited value in forecasting requirements of manpower, finance and other variables related to production and sales. Because of the recognized inadequacies of the budgets no detailed analysis is made of variances between budgeted and actual expenses at operating levels, unless such variances are

obviously out of line with reasonable performance. Aside from the "forecast of sales" aspect, the general lack of accountability for and determination of inefficient operations precludes the preparation of realistic budgets. The budgets seem to be more based on past performance (which has proven to be a good guide in many areas) than on a careful detailed analysis of the forthcoming year's anticipated operations.

It is recommended that more emphasis be placed on budgets as a high level prediction of overall Company performance and requirements for the year and as a comparison at all levels of actual versus expected performance. This will require the application of more care in the preparation of budgets. However, the incorporation of other recommendations contained in this report should make preparation of realistic budgets feasible.

Reports. The reports prepared by the Accounting Department are considered to be adequate. However, the value of these reports is limited by the fact that it is impossible to determine true costs under the current method of allocating factory burden.

It is not believed that full use is made of available information in the preparation of the monthly cash budget. Estimates of both receipts and payments seem to be made more on an average basis than on an analysis of what can be expected for a given month.

Much of the information contained in the daily financial report is not significant on a day-by-day basis. It is recommended that consideration be given to revising the format of this report eliminating any obsolete or undesirable features and that this report be made a

weekly rather than daily report.

Recommendations

1) Prepare job descriptions or lists of duties and responsibilities of Cost Engineer and of Accounting Department personnel.
2) Install standard cost system so that responsibility and accountability can be assigned and determined for all costs; and so that true costs and profitability of different products and jobs can be determined.
3) Break down "Finished Goods and Work In Process" account to give more information about turnover rate and inventories of various product lines.
4) Establish records of maintenance costs (both mechanical and electrical) for individual machines.
5) Inaugurate report showing performance of individual production workers on a weekly or monthly basis.
6) Place more emphasis on preparation and use of budgets at and for all levels.
7) Revise format of daily financial report and make it a weekly report. If cash budget is considered unsatisfactory, use additional available information to improve it.

PART X

OFFICE SYSTEMS AND RECORDS

Office systems include the combination of all office methods and procedures employed in the conduct of business. Records are the written or otherwise preserved documents that are generated and used in the conduct of business. Other parts of this report touch briefly upon specific office systems and records, but office systems and records as discussed herein consists primarily of those employed in the general office of W. & L. E. Gurley as there was insufficient time to survey each office.

Findings

The latest organization chart of W. & L. E. Gurley shows that the Office Supervisor reports to the Executive Vice President. The Office Supervisor is responsible for general office systems and records.

Incoming Mail. All incoming mail is picked up from a Post Office mailbox prior to office hours. It is opened, sorted, matched with referenced letters if they are in the general office's files, and delivered by the several clerks to the major heads of departments so that they can review their mail prior to the nine o'clock morning meeting. No record is made of receipts or distribution. A routine procedure to see if mail requiring a reply is answered or to see if the correspondence is returned for files is not in use. It is the responsibility of the receiving official to do whatever is necessary, such as forwarding it to another official, answering the letter, filing the correspondence in his office files or returning it to the general office

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

for filing. Some officials initial the letter to indicate that they have seen it and may even annotate a brief of action taken. When sales and order letters, the primary source of mail, are returned to the office, they are filed alphabetically by originating enterprise's name. Purchase and Accounting Department letters are maintained in their individual files. Approximately five hundred (500) pieces of mail are received weekly.

Outgoing Mail. Outgoing mail is originated and signed by the Company officials who are cognizant of it. Formal guide lines regarding the extent to which each originating official can commit W. & L. E. Gurley do not exist; so each originator determines the limitation of the nature, scope and contents of his letter. Without formal reference to other concerned officials, the outgoing mail is sent to the office for sealing and stamping by a stamp machine. In some cases the originating official retains the W. & L. E. Gurley file copy; in other cases two file copies are delivered to the office for filing. One is placed in a file which contains a copy of each correspondence originated that date, and the other one is filed alphabetically by addressee's company name. The daily file of outgoing correspondence is routed to some of the major department heads and the Executive Vice President, but not to the President of the Company. The primary use of the daily file is to assist in locating W. & L. E. Gurley's letters that are referenced in subsequently received letters. These daily files are retained for three months and then destroyed by burning. Approximately five hundred (500) pieces of correspondence are originated weekly. The bulk of it being sales, purchasing and accounting correspondence.

Records File. Office files are actively maintained for a two-year period and are then stored for a minimum of an additional ten years in the Parker House.

Estimating Letters. When letters quoting repair estimates are prepared, a special copy called a "chaser" is made and filed chronologically for the date of follow-up. When this date is reached, the "chaser" copy is pulled and forwarded to the cognizant department so that another letter may be prepared if it is deemed advisable. A search of pertinent files to see if the business has been consummated prior to forwarding the "chaser" to the appropriate department is not made.

Difficulty of Locating Correspondence. Some temporary loss of mail is experienced; however, with the long experience and good memory of office personnel and the forbearance of department heads, most mail is found. Also difficulty is experienced in locating some received letters because of the following: (i) the originating companies have more than one name; (ii) they sometimes change names; (iii) they write under a different divisional name; and (iv) they may reference the wrong subject. It is estimated that about eight times a week a more thorough search than a routine check of the files must be instituted in order to locate desired correspondence.

Correspondence Regarding Business Leads. When W. & L. E. Gurley supplies requested publications, it furnishes details by means of a form letter to its dealer who can best service the prospective customer. In case anticipated business is not apparent within a reasonable time a routine follow-up is sent to the dealer. As W. & L. E.

Gurley has no way of knowing if the information furnished did actually result in a business transaction, the routine follow-ups are almost always forwarded to its dealers.

Miscellaneous. All office personnel act as receptionists and as switchboard operators for outside calls on a first-see, first-do basis. Either of these duties requires the discontinuance of routine duties and the walking of from ten to twenty feet to the receptionist's window and/or the switchboard, which is located there, as well as the return to routine duties.

Specific duties are not assigned to each office employee although there is some degree of specialization in secretarial and filing work.

As there is no scheduled routine interoffice pick-up and delivery of mail, use of routine interoffice memoranda are precluded.

Each official designs his own forms and there is not a file of all active forms anywhere in the Company.

There is no file of standard operating procedure, temporary operating procedure or of any policy decisions.

Appraisals and Conclusions.

Mail Routing Slip System. The receipt of any but the smallest amount of mail creates a need for some formal system to determine what mail has been received, what action was required and what disposition was made. No such system is currently in use. It is not possible to determine from an office record what mail has been received or to find a piece of correspondence in the files by knowing its date

or origination, nor can correspondence not filed be readily located.

The simplest system for accomplishing location of letters referred to by date written by others or letters still in routing is by the use of a routing slip system. A good mail routing slip system for any but a large company could be confined to a simple form used in duplicate. The form should provide space for identifying the correspondence by originating company, date written and subject matter, as well as date received, interoffice routing, action to be taken, a space to cross-reference where filed and a space to indicate action taken such as answered by letter of date and file number, or parts shipped on shipment order number ______ by parcel post, and so forth. The original of the routing slip could be attached to the correspondence while it is being routed. The duplicate routing slip, of a different color, could be filed chronologically by dates of receipt until the correspondence returns to the general office. The duplicate file would show in addition to that information listed above, which mail is outstanding and each letter's routing to specific departments. If this duplicate were removed from the chronological files upon return of the original letter to the files, it would be a very simple matter to locate mail still in routing by use of the departmental routing slip file. Upon return of the routed letter the original and duplicate routing slip, if retained, should be cross-referenced to file data. The original could be removed and placed in a chronological file by date of origination of letter. The copy could be either filed by subject matter or destroyed, depending upon the needs of the Company. In cases where only one department makes use of the correspondence, consideration can be

given to forwarding its mail to that department without a routing slip if the department itself employs some method of logging and accounting for its correspondence. There are, however, advantages to be realized through the routing slip system that cannot be realized through this method.

Referring Outgoing Letters to Interested Managers. Outgoing letters can commit other departments to courses of action without their knowledge. This could be overcome by establishing formal quick lines as to the extent of the nature, scope, contents and limits that each originator can use. In cases where more than one department is involved or the letter exceeds established guide lines, the Company's file copy of the letter should bear the initials of the other involved management personnel and their comments in cases where there is disagreement. Such a procedure would serve to prevent arguments later.

Follow-ups on Estimating Letters and Business Leads. The system of follow-ups on estimating letters is considered a good one. If clerical personnel researched the files, it would not be necessary to bother department heads with follow-up notifications in those cases where work has already resulted from the first estimate. Also this should give a greater assurance that a follow-up letter is not sent out when a contract had been entered into for the work.

The practice of notifying W. & L. E. Gurley dealers of possible customers as a result of furnishing information or publications is good. Maybe if a business reply postcard were forwarded at the same time requesting the dealer to check the questions and statements thereon to indicate what action was taken and the results obtained, it might be

possible to evaluate not only this system but also, to a certain degree, to evaluate the aggressiveness of the dealers.

Inter-office Mail Service. A more formal system of inter-office delivery and pick-up would free managers and others of higher pay from these clerical duties. Some one employee should have the responsibility of making pick-ups and deliveries on schedule, and department heads and others should be discouraged from effecting routine hand deliveries.

Review of Non-Routine Letters. It is felt that originated letters of non-routine nature should be referred periodically to the President so that he may keep abreast of these activities with a minimum of effort. Perhaps the Executive Vice President could, upon reviewing the daily file of outgoing letters, refer to the President those letters of high significance.

Review of Dead Letter File Policy. Prior to, and certainly no later than when the office or plant layout changes discussed in this report are considered, a review should be made of the frequency and nature of referring to those files in the Parker House with a view to reducing handling and the storage space required. Maybe it would be more economical to use microfilms or to eliminate a portion of these files prior to placing the records in storage for a ten-year period.

Utilization of Modern Management Principles. Specialization is the principle of modern organization which attains economy of individual effort. This principle is applicable in the office of W. & L. E. Gurley. In the interest of saving time and effort as well as favorably impressing W. & L. E. Gurley's public it is felt that one office employee

should have a desk at the receptionist's window similar to that shown on the proposed drawing in the part covering Plant Layout.

With so few personal secretaries and so much mail being routed to a few departments, it is felt that consideration should be given to assigning a secretary to the Sales Department.

A further extension of the specialization principle would be the assignment of specific duties to all office employees. These persons could be rotated in the different assignments so that there would be qualified personnel available during leave periods and other occasions of absence.

Forms and operating procedures attempt to define and standardize ways of doing things. It is felt that W. & L. E. Gurley should gather all existing forms and review them with a view to simplifying, combining and improving all forms. Standardization on size alone would facilitate handling forms and more than likely would reduce printing cost. Standardization of forms and the requirement of review by a committee prior to the adoption of a new form would instill a degree of stability into normal operations. Standard operating procedures should be used throughout, in so far as they will suffice, but when they will not serve the purpose temporary procedures should be established. These procedures are the standards for performance and standards of performance are a necessity for modern management. One place in the Company should have a file of these standards. It is felt that the office is the best place for a central file.

Recommendations

The following recommendations are submitted:

1) That a mail routing slip system be instituted.

2) That outgoing letters that are of interest to other management personnel be referred to them for initials and comments prior to release.

3) That clerical employees research files to see if business has been consummated prior to forwarding follow-up letters to cognizant managers.

4) That a method be devised to measure the effectiveness of dealers' use of leads supplied by W. & L. E. Gurley.

5) That an inter-office mail pick-up and delivery system be instituted.

6) That non-routine letters be reviewed periodically by the President.

7) That the dead letter file policy be reviewed with a view to reducing the storage space and handling required.

8) That a receptionist desk be placed at the receptionist's window and that it be staffed by office personnel.

9) That specific job assignments of office personnel be made in writing and that these employees be rotated periodically for short periods of time so that each employee can do each job in case of necessity.

10) That a forms control program be instituted and periodic reports of progress and difficulties encountered be required.

11) That a system of standard operating procedures be instituted and that each department be responsible not only for initially establishing and recording its own, but also for recommending proposed

procedures where overlapping responsibilities exist. In the long-range plan set up a committee to review, revise and publish periodically all standard and temporary operating procedures.

12) That standard operating procedures be established whenever uniformity will significantly increase the effectiveness or decrease the cost of work.

PART XI

INDUSTRIAL RELATIONS

Findings

The industrial relations functions which are actually performed at the Gurley Company are so divided and decentralized that it would be very difficult, if not impossible, to coordinate this phase of the business effectively at this time. A great deal of information concerning this subject, which was received from various Company officials, indicated that there were some misconceptions between personnel of the Company as to where certain industrial relations responsibilities lie. Because of opposing views as to these responsibilities as well as unfamiliarity, considerable difficulty was experienced in gathering completely accurate information on the actual operation and handling of the various industrial relations functions of the Company. For this reason the Findings cannot be considered correct as seen by each official of the Gurley Company, but are the best conclusions that can be made based on all the information gathered from the various sources contacted.

Union Contract. The bargaining unit which represents the employees of the Company is Local 12770 of the United Mine Workers of America, District 50. It appears that an excellent relationship exists between the Gurley Company and the Union. The present effective agreement was negotiated on May 10, 1954 and is binding to both parties until May 10, 1955. This agreement (see Figure XI-1)* specifically covers the following information: parties to the agreement, coverage and exceptions, collection of Union dues, seniority, hours of work, overtime

*With the Plant Layout drawings in the last volume.

payment, holidays, wages, vacations, discharges, adjustment of grievances, leave of absences, general procedure, work interruptions, pensions and terms of the contract. A brief resume of each one of these phases of the agreement follows.

Parties to the Agreement. The agreement is between W. & L. E. Gurley and United Mine Workers of America, District 50, Local 12770.

Coverage and Exceptions. The Company agrees to recognize the Union as the sole and exclusive bargaining agent on behalf of all the employees to whom the contract applies with the exception of the following classes: Executives, Superintendents, Foremen, Office Employees, Designers and Engineers.

Collection of Union Dues. The Company agrees to check the wages of Union employees for dues and initiation fees. This action is subsequent to receipt of written assignments from each employee. This section also includes an agreement that there shall be no discrimination against employees because of Union membership.

Seniority. Seniority in this company means length of service in the Company on a departmental basis. In laying off or rehiring, seniority rights will be first consideration. When vacancies are filled by transfers to higher classification or promotion, the principle of seniority shall govern where skill, knowledge, physical capabilities and experience between employees are equal.

Hours of Work. Eight consecutive hours of work (excluding lunch period) constitute the working day. Forty hours of work of five consecutive eight-hour days, Monday to Friday, constitute the week's

work. Daily working hours are the prerogative of the Company to set in accordance with the needs of the business.

Overtime Payment. Work performed by employees in excess of eight hours a day or forty hours a week is paid at an overtime rate of one and one-half the regular hourly rate. Saturday work, except custodial workers, is paid time and one-half. Sunday work performed irregularly calls for double rate payment.

Holidays. Qualified employees receive six paid holidays per year. If the employee is required to work on a holiday he receives a total of double the regular hourly rate. Time off with pay for two hours is allowed on Election Days for voting.

Wages. The minimum starting rate for male employees is $1.25, female employees, $1.05. New employees receive a ten cent raise at the end of a thirty-day probationary period. Night shift differential premium is ten cents per hour except for custodial workers.

Vacations. Employees who meet all regulations normally receive one week's paid vacation for up to two years' employment, one and one-half weeks' paid vacation for three and four years' employment and two weeks paid vacation for five years or more of employment. These vacations may be taken between June 1 and October 1. The Company has the right to specify that a department or the entire plant shall take their vacation at the same time.

Discharge and Grievance Procedures. Employees are subject to discharge for just cause. A disputed discharge is subject to the grievance procedure. The grievance procedures are set out very specifically. In general the Union elects a shop committee which acts as the Union representative in the shop. The necessary number of

stewards are also elected for various departments. Management recognizes and deals with these elected representatives. When disputes arise they are settled and determined by the following procedure:

1) The employee involved or a shop steward takes the matter up with the foreman for adjustment.

2) If adjustment is not effected within twenty-four hours, the issue is written and reviewed by the shop committee and the Company committee with a decision or agreement to be reached within two working days.

3) If the issue continues to remain in dispute, a Union representative and the Company attempt to cause adjustment within two working days.

4) Upon failure at the previous step the issue may be referred within five days by either party to an impartial arbitrator. The arbitrator's decision is final and binding upon all parties.

Grievances and disputes must be filed within one month from the date of the alleged occurence.

Issues for arbitration are confined to matters arising as to the application or interpretation of the agreement in relation to the issue in dispute.

Expenses relating to arbitration are shared equally by the parties.

The Gurley Company has had approximately five cases reach the third stage of grievance procedure during the past year where satisfactory adjustments have been made. There have been no cases where a dispute or a grievance has gone to an arbitrator. The majority of

cases are settled very quickly by the foreman. The Company states that good labor relationships are enjoyed with their employees.

Pensions. There is one new subject in the contract which was introduced last year. This is the pension plan which is included in the present contract. This plan provides that this company pay to a corporate trustee 2 3/4¢ per hour on all hours worked during the previous calendar month by all persons employed in the bargaining unit. This plan starts paying to the employee when he is sixty-five years of age and retired. To be eligible the employee must have been employed a minimum of ten years in which case he would receive ten dollars per month. The payment increases one dollar per month for each additional year employed up to twenty dollars per month which is the maximum pension paid.

Rules. The agreement contract between the Union and the Company is the only set of official rules by which human relations are governed. There are no rules set forth by the Company in addition to the Union contract.

Union Contract Negotiations. Negotiations with the Union for renewal of contract are normally handled for the Company by the Plant Manager, the Chief Engineer and an Institute of Management Affairs representative. Meeting with Union representatives these people, through collective bargaining procedures, arrive at the operating contract for the coming year.

Personnel Employment. Recently the Company assigned the duties of personnel employment to one person. Previously, hiring was done by the manager concerned. Now all vacancies are reported to the

designated person with the job requirements. He then attempts to fill the vacancy using such employee lists as are available or any other source he can find. When the prospective employee reports for interview, he is handled by the designated person who decides whether the prospect meets the general requirements. The foreman who requires the new employee conducts the second interview with the prospective employee. At this time the position is explained to the prospect; he is given any oral examination necessary by the foreman and, if the prospect is satisfactory, the final decision to employ the individual is made by the foreman. Final processing of the required paperwork is done in the main office. A thirty-day review is made after hiring a new employee to determine whether the foreman is satisfied and whether he will agree to final retention. Since the employee is on trial during the thirty-day period, it is important that the review be conducted prior to or just at the end of this period. For this reason the cost department sends a tickler note to the foreman just prior to completion of the thirty days. The routine of the hiring procedure seems to be standard in that the required New York State form is used, a physical examination is required before starting work and record-handling is routine. The determination of what the wages or salary to be paid is one which appears to be quite hazy. It appears that a policy exists whereby the Company pays as little as necessary in order to get the prospective employee. The rate must be a close approximation of the area wage rate but a systematic method of wage payment is not presently being used. Pay records and records concerning each employee are kept in individual folders in the main office of the Company.

Job Evaluation. There is no system of job evaluation in effect in the Company at the present time. In 1949 the Company contracted with a consulting firm to prepare and install a job evaluation system in the plant. The system which was developed was not installed because of Union opposition to the plan. This probably was due to improper procedures used during the planning and developing stages of the system. Apparently not enough thought and effort were given to selling and gaining acceptance of the plan by the Union and all other employees. The present scale of wages is done by a rule of thumb method with only a minimum amount of consistency in wage policies. The present method appears to be based on individual bargaining between the employer and the employee in all cases. The only specified wages are the minimum requirements which were stated in the contract. Present rates now vary from $1.35 per hour to $110 per week paid to the foreman. A rough division of rates would be: custodial workers, $1.38 to $1.46 per hour; semi-skilled employees, $1.35 to $1.60 per hour; skilled employees, $1.40 to $1.85 per hour; and skilled technical employees, from about $75 to $100 per week.

Job Descriptions. There are no job descriptions available in the Company. Job requirements are stated verbally by the foremen when he is interviewing prospective employees or when up-grading or promoting to better positions within the Company.

Merit Rating. Merit rating of any employee consists of the personal opinion of the foreman for whom the employee works. The Company does not have or require any records for merit rating. Any records which might exist would be records which individual foremen

or supervisors have kept themselves.

Training. The majority of training which is conducted by this company is on-the-job training. The only other training program which is in force is one recently initiated for the training of foremen. This program is being executed by the Institute of Management Affairs' representative who is under contract to provide industrial relations technical advice and services. Actually very little on-the-job training is conducted since most of the employees hired are experienced and require little more than supervisory instruction.

Beneficial Suggestion. A beneficial suggestion program has been established within the last few months in an attempt to encourage employee enthusiasm in their work and to create a feeling of personal participation while recognizing special endeavors with proper and appropriate monetary and/or certificate reward.

The program began with the establishment of a committee consisting of the chief engineer and five shop representatives. Operating rules were prepared which are basically as follow:

1) The committee meets twice a month to review suggestions turned into the committee by the employees during the previous period.

2) The committee reviews a suggestion and votes on whether or not it is considered satisfactory.

3) If it is not satisfactory, it is returned to the one who suggested it with an appropriate note. If it is satisfactory, the one who suggested it is issued a Suggestion Award Certificate signed by two of the committee members. The suggestion is then forwarded to management for consideration.

4) Management reviews satisfactory suggestions and determines whether or not to adopt them. If adopted an initial award of from ten to twenty-five dollars is made. At the end of one year's use an additional award may be made.

No written rules exist as to who may participate and what the specific eligibility requirements are. In addition, no rules as to how financial rewards are determined nor any rules as to time limitation for the submission of a suggestion after actually being in effect for a period of time are presently available.

The committee has prepared a form for use by those making suggestions for use in submitting them. These forms are filled in by the employee showing date of submission, part involved, what the suggestion is, signature of the person making the suggestion and signature of committee representative. A form has also been prepared for use of the committee showing what action the committee took on each suggestion acted upon. This form has space for the committee's recommendations or reason for rejection. After being filled in it is given to the person who made the suggestion as notification of committee action.

Since the program is still in its infancy, not much data has been accumulated as yet. A number of suggestions have been submitted and processed with about three actually having received a cash award.

Safety. There is no coordinated safety program in the Company. That is, there is no person designated as a safety engineer or safety program coordinator. However, all supervisors are considered to be responsible for safety within their shop spaces and operations. No written rules of safety were found, and in most cases safety measures

seemed to be left pretty much to the individual operator. As an example, in the case of a machinist operating a lathe the machinist wore safety glasses if he desired.

Since there was no central coordination, there were no overall safety records available; however, it appears that there are not any significant accident-prone areas or people in the Company.

Wet line fire sprinkling systems are installed in a good number of the shop and storage areas about the buildings. In addition hand-operated fire extinguishers of various types are located in strategic areas.

There is an inspection of the plant and office facilities made weekly. The purpose of this inspection appears to be for two major reasons: safety and cleanliness. The department or shop which is graded low is "awarded" a doghouse which denotes corrective action needed or required. The use of the symbolic doghouse seems to be quite effective as several comments concerning this unwanted trophy were heard.

Employee Welfare. The program of welfare in the Company includes such items as vacations, retirement, clubrooms, indoor parking facilities and a beneficial suggestion system. There are no Company sponsored activities such as picnics or parties. The condition of the plant in general is not conducive to high employee morale because of poor lighting, dirty windows, wash room facilities, and old and improvised equipment. Although there is a definite attempt to create a "family attitude" among the employees, it is questionable as to the degree of success which has been achieved.

Appraisal and Conclusions

In considering industrial relations functions in small companies we should be prepared to answer questions concerning the size and expenses which should logically be incurred by the small company. This question is a very important one and not easily answered. The problem in human relations, however, which confronts management in a large company is identical in type with the problems of a small company. In both cases there are certain functions which must be performed. The difference between these functions varies only in magnitude between large and small companies.

A small company must distribute many industrial relations duties among various executives and line officials. Wide distribution of these functions means that excellent coordination and review is necessary to insure the good relationships with the employee which the company desires.

The appraisals and conclusions concerning the Gurley Company's industrial relations policies will be approached in accord with the thoughts presented above.

Union Contract. Industrial relations play a very important part in the relationships which exist between the Union and the Company. The Union agreement covers such industrial relations functions as: seniority clauses, promotions, wages, vacations, grievance and disciplinary procedures, and the pension plan. Since the Union agreement concerns such vital functions, it in fact provides the base structure of the industrial relations program of the Company. It is therefore very important to have a very strong industrial relations program in order

to go into the collective bargaining phase of the Union contract from a strong position. It is believed that as conditions in the Company permit it would be advisable to strengthen the industrial relations functions now performed in the Company and to encompass other functions not presently being performed. This strengthening process would possibly assist the Company in their bargaining position with the Union. This assumption is based on the fact that if the Company's policies are acceptable to the Union, less difficulty might be experienced during the contract negotiation. If trends of Union demands are noted, it could become Company policy to attempt to reduce pressure of these demands by concentrating industrial relations activity in that area with the hope of providing a strengthened bargaining position for the Company.

Personnel Employment. Setting up one individual to handle all employee recruiting for the Company is considered to be a step in the right direction. Basically, it lends itself to uniformity in employment practices which is a necessity for proper and efficient selection of personnel. Careful employment practice is important both to the Company and to the individual; for if the employee fits the job well, he will do it better, with greater ease and with more satisfaction, thereby resulting in a real asset to the Company.

Job Evaluation. This phase of industrial relations, although important, need not be considered seriously at this time. It should be considered after work has been completed on recommendations contained in the Methods and Plant Layout part of this report. At that time, perhaps an appraisal of job evaluation should be made in order to establish a uniform wage and salary system. At the present time the

only required wage payment is the minimum wage contained in the Union agreement. All other wages are fixed by an informal method which gives most consideration to the "going wage rate" in the area.

Job Descriptions. Since job descriptions do not exist at Gurley, it is felt that here lies the reason for the large number of conflicting statements as to the responsibilities of various individuals in the organization. In some cases, people do not know who their immediate superior is. In others, several supervisors felt that the same individual reported to them. This situation is certainly not conducive to good personnel administration.

In the case of the shop trades it is felt that basic descriptions for the trades are all that is required. However, for supervisory, engineering and office employees complete and individual job descriptions should be prepared delineating the content of each job.

Preparation of job descriptions should be considered sometime in the future after other more pressing problems of production and organization have been solved.

Merit Rating. Merit rating systems, once established, are of considerable assistance to management in cases of promotion, transfer, wage increases, lay-offs, and in grievance and disciplinary matters. The present informal system which is in effect consists of the foremen's personal opinion and knowledge of the employee. When an opportunity presents itself in the future, it is suggested that thought be given to inaugurating a simple, adequate, merit rating system prepared in written form. Prior to installation of such a

system, research should be made in good reference books to insure a successful program.

Training. The present foreman training program apparently needs some revitalization for it appears to have become dormant. Although it has not been officially discontinued, it is not in actual operation. Here is an area where considerable value can be received if the program were set up on a regular basis, with a good series of subjects to cover various problems with which the foremen are faced daily. Any new Company plans, such as merit rating, could be discussed at these meetings prior to actual incorporation. The foremen would feel that they were "in on the decision" so to speak, as well as have a thorough knowledge of how the plan works and would handle the system from an entirely different view when it was finally set into operation.

Since the total employment and labor turnover is small, many formal training programs are not considered necessary. The foreman program should handle all regular training needed. Executive training on Company organization and policies is evidently necessary since various executives have various ideas of actual Company relationships and policies, as evidenced in other sections of this report. This training need not be on a regular basis, but can be accomplished occasionally at executive meetings. Along this same line, occasional necessity for on-the-job training may appear in training a new employee or a transferee. Here, too, no formal program should be necessary.

Beneficial Suggestion System. The recent inauguration of the beneficial suggestion system is an indication of progressive thinking at the Gurley Company. Programs of this type have proved of great

value both financially and with respect to employee morale in many companies that have adopted them. A quick review of the Gurley plant layout and methods indicates a fertile field for a program of this type.

There are many different thoughts on the specific operation and the value of suggestion systems. Like anything else, however, if it is not supported by management and efficiently controlled, it can do more harm than financial good.

Until recently, only a few suggestions have been processed through the Gurley system. The personnel involved seem sincere in their desire to do a good job and administer the program expeditiously and properly. However, it is desired to point out that a good number of the normally accepted ground rules on points of issue have not been spelled out. This means that each time these points come up in actual practice, decisions will have to be made which, whether biased by individual personality or not, will appear that way to some of the interested parties. Some of these points which need clarification now are: (i) who can participate? (ii) what are the eligibility requirements for awards? (iii) how will financial awards be determined? (iv) after actual use, what time limitations should be set on formal submission of suggestions?

One other aspect of the present plan which seems wrong is the idea of having the suggestion committee composed of plant employees. Now, if the committee rules a suggestion of value, it grants an award certificate. After that, management reviews it and determines whether or not to adopt the suggestion. Here is the real potential

trouble spot in the entire plan. If management now rejects, the employee's natural feeling will be that he has been subject to discrimination. It is felt that immediate steps should be taken to change the membership of the committee. It is suggested that some book such as the National Industrial Conference Board's _Studies in Personnel Policy No. 135_, "Suggestion Systems" be studied. Here can be found all the necessary principles concerning operation of suggestion systems.

Safety. The fact that no coordinated safety program exists is not an indication that there is not activity in this vital field at Gurley. As a matter of fact, on taking a tour through the facilities one sees a number of safety posters, well placed fire extinguishers, fire sprinkling systems and other signs of safety consciousness. In addition the regular Friday afternoon plantwide household inspection, with its written report, leads to good housekeeping which is a big part of any safety program. All of these activities seem to be the responsibility of the foreman concerned.

Truly, safety is a line responsibility; however, experience in many activities has shown that safety is a plantwide matter that should be coordinated and planned on an overall activity basis and administered on the operating level. In this manner safety can be a controlled function and the line supervisor can be assisted in keeping up with safety developments.

The lack of such overall coordination is most evident when attempting to get information as to Gurley's safety records. Since no central control exists, no records are available. A further investigation reveals that safety glasses are worn if the individual employee

feels they are necessary.

If one person were placed in charge of safety coordination, he could see to it that a program were laid out for instilling real safety consciousness in all employees. He could organize a safety committee of management and shop employees to assist in reviewing and planning the program. Reports could be maintained and safety sold to all concerned.

Welfare. In the area of welfare the Company is active in such things as paid vacations, retirement plan, beneficial suggestions, bulletin boards, clubroom, and indoor parking facilities. All these activities help make employees glad they are with and a part of an organization. Additional activities that could be organized and run are: (i) recognition plans such as length of service awards and merit awards; (ii) recreation activities such as bowling and softball leagues and Company picnics, fishing trips, golf groups and camera clubs.

The one area of employee welfare that is sorely in need of review is the general work and rest spaces of the plant. Dirty windows, poor lighting, antiquated toilet facilities and the general appearance of the plant facilities do not make for high morale or worker efficiency. Granted, the buildings are there and cannot be replaced without large money expenditures, but much can be done toward making them more cheery and bright. A good coat of paint using DuPont's latest industrial color schemes would go a long way in making things brighter and even safer. A systematic, planned remodeling of all toilet and lighting facilities would undoubtedly result in happier employees.

Recommendations.

It appears that the major changes which would be most beneficial to the Gurley Company in their industrial relations program would be to achieve better coordination and to specifically delineate and assign industrial relations duties to insure that adequate and satisfactory attention is being given to each phase of this program.

1) The first recommendation is to assign one person the responsibility of organizing and coordinating all phases of industrial relations. It should be the responsibility of this Industrial Relations Manager to prepare written instructions of policy under which the department will operate. He should also initiate procedures for insuring satisfactory coverage of all phases of the department. The industrial relations manager, in addition, should be responsible for setting up the departmental organization, insuring that required position descriptions are prepared and making assignments of certain functions to individuals. In short, the manager should spearhead the organization in all respects until it is operating properly. He then would be able to supervise the administration of the department.

   It is expected that in most cases individual assignments of industrial relations duties would be on a collateral basis. Working time must be allowed the employee for performance of these duties.

2) The second recommendation, presented for future consideration, is to consider implementation of a simple, adequate system of merit rating prepared in written form.

3) It is suggested that the question of job evaluation and subsequent wage and salary rate setting be reopened at an appropriate future date in order to establish an equitable, systematic wage scale.
4) It is recommended that a thorough review of the present beneficial suggestion system be made with the goal in mind of correcting present inadequacies and strengthening and setting forth the policies under which it is now being operated.
5) It is suggested that more attention should be given to the phases of safety, training and employees welfare. Improvements in these fields need not be excessively expensive, but planned prudent expenditures could be made.
6) It is recommended that future consideration be given to preparation of general job descriptions for the basic shop trades and for specific, individual, job descriptions for supervisory, professional and office personnel of the entire organization. The industrial relations department should coordinate this plan. These job descriptions should be prepared after acceptable changes recommended in other parts of this report are effected.

It is realized that a large or expensive industrial relations department is not required in the Gurley Company. It is believed, however, that adoption of the above suggestions would greatly strengthen the industrial relations program at W. & L. E. Gurley.

PART XII

ORGANIZATION

Findings

A review of the W. & L. E. Gurley organizational structure reveals numerous formal and informal lines which are not in agreement with the published organization chart. The latest chart was prepared in 1952; and a number of billet and employee changes have been made since that date. The chart shows six people reporting directly to the President, whereas, actually, there are ten or more so reporting.

It was found that changes in organization structure were occurring continually, to the extent that even formal lines were no longer understood by some of the executives. Below the executive level very few employees were found who could describe the organizational structure with any degree of accuracy.

The Chairman of the Board of Directors of W. & L. E. Gurley daily serves in a working capacity in the plant during which time he is responsible to and reports to the President. However, during Board meetings he, speaking for the Board, directs the President. His daily working status in the plant is neither fully understood by this survey group nor the employees of W. & L. E. Gurley.

Appraisal and Conclusions

Although an organizational chart of the Company, shown on Figure XII-1, was prepared in 1952, numerous employees at all levels appear to lack an understanding of the actual organization, and the

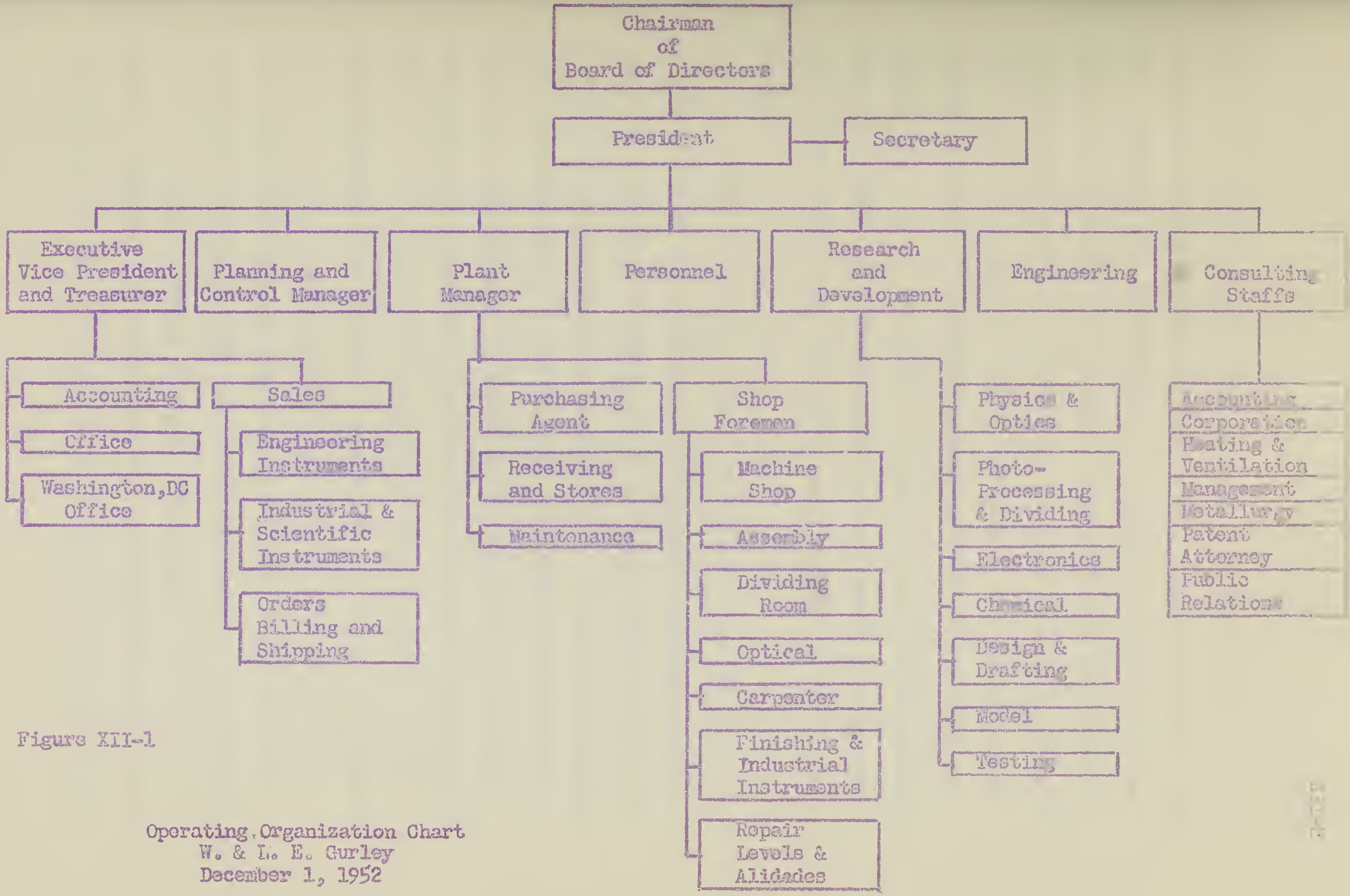


Figure XII-1

Operating Organization Chart
W. & L. E. Gurley
December 1, 1952

individual responsibilities and authorities of its members. As mentioned in other sections of this report, there is a general vagueness concerning the coordination of the Company's efforts; and nowhere are the duties of any position clearly defined in writing. It is recognized that W. & L. E. Gurley is a small company whose members have worked there for many years. However, it is felt that one of the major faults of the present organization is that it is too informal. It is concluded that top management could well devote attention to formalizing the Company organization, keeping it up to date, and defining the duties, authorities and responsibilities of its executives.

Under the present organization the President's span of control is too wide with at least ten subordinates reporting directly to him. Such practices as having the head of the Photo-Laboratory and the Chief Draftsman reporting directly to the President is unorthodox and seems unnecessary. Even though the Purchasing Department is under the Plant Manager in the present organization, all purchase requisitions are approved by the President with the Plant Manager and Planning and Control Manager essentially being by-passed. Other similar examples have already been cited in this report, and they all impress this survey group that the President is too often tied up with numerous details and responsibilities which could be clearly delegated to other executives. The President of an organization should be able to concern himself primarily with analysis and study of major Company problems. It is concluded that the President should not only delegate some of his authority to his subordinates, but also enjoin

management personnel at all levels to exert maximum initiative and discretion in their work within a framework of assigned authority and responsibility.

It is normal for chairmen of boards of directors to have a valuable storehouse of knowledge and experience which would be available to a company only in the capacity as chairman of the board of directors. It is felt that the present Chairman of the Board of Directors, who is a former President of the Company, could best serve W. & L. E. Gurley in such a capacity. His daily presence in the plant has a way of focussing his attention upon minute operating details and obscuring his primary purpose which is to establish and guide overall Company objectives and policies. Also, in view of his past position in the Company his presence and daily conversations carry a connotation of operating authority which naturally supersedes the immediate supervisor's delegated authority and responsibility.

For these reasons it is felt that the Chairman should not be active in the daily operations of the Company. His value should be realized through normal channels and the day-to-day operations should be the sole responsibility of the President and his managerial personnel.

Two new positions, those of Manufacturing Manager and Comptroller, have been recommended on the proposed organization chart, Figure XII-2; and a few functions have been assigned titles that are new to W. & L. E. Gurley's organization. This was done to improve the President's span of control and to provide better coordination and control for related functions. It is felt that consideration

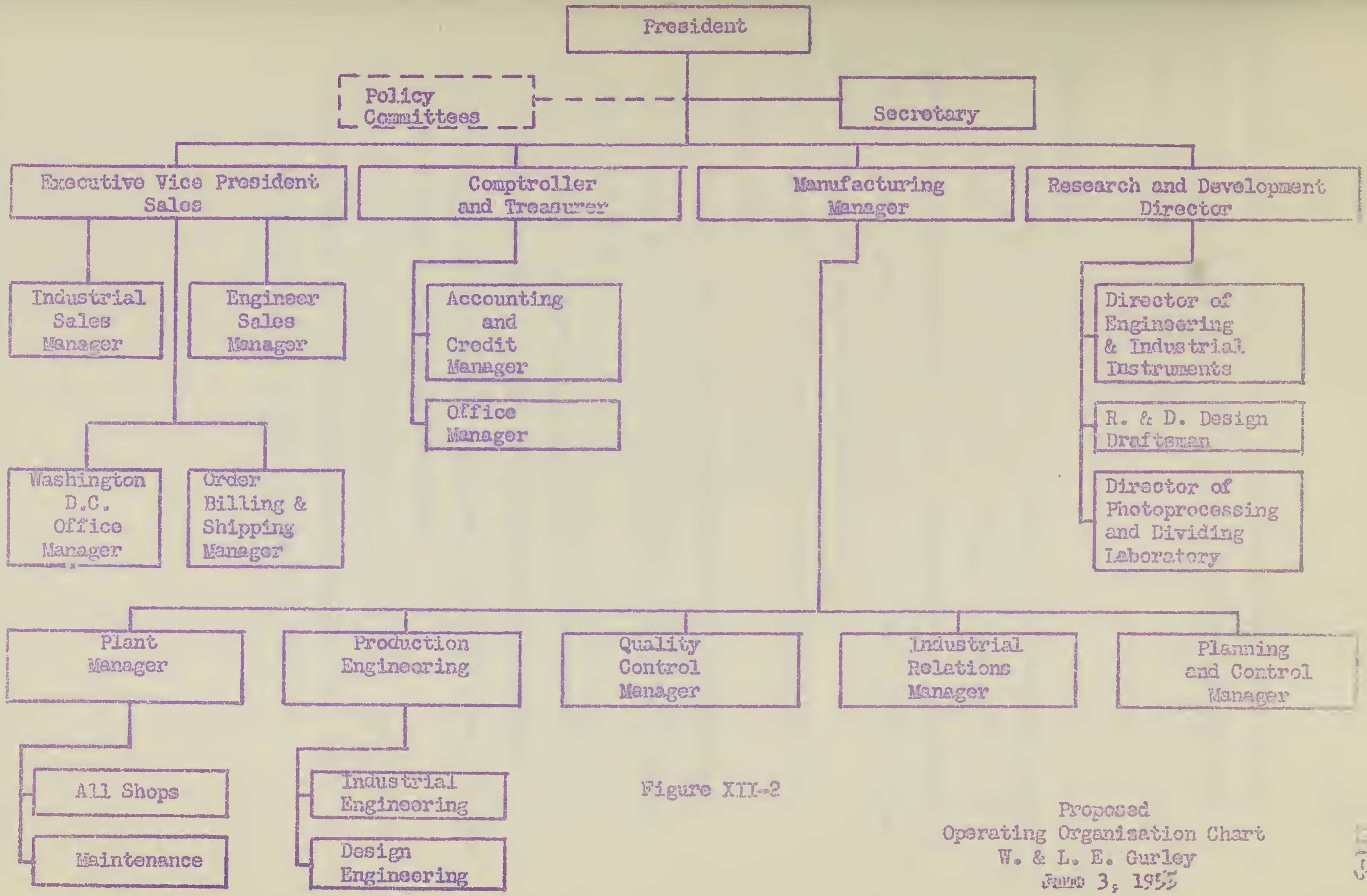

President
Policy Committees
Secretary
Executive Vice President Sales
Comptroller and Treasurer
Manufacturing Manager
Research and Development Director
Industrial Sales Manager
Engineer Sales Manager
Washington D.C. Office Manager
Order Billing & Shipping Manager
Accounting and Credit Manager
Office Manager
Director of Engineering & Industrial Instruments
R. & D. Design Draftsman
Director of Photoprocessing and Dividing Laboratory
Plant Manager
Production Engineering
Quality Control Manager
Industrial Relations Manager
Planning and Control Manager
All Shops
Maintenance
Industrial Engineering
Design Engineering

Figure XII-2

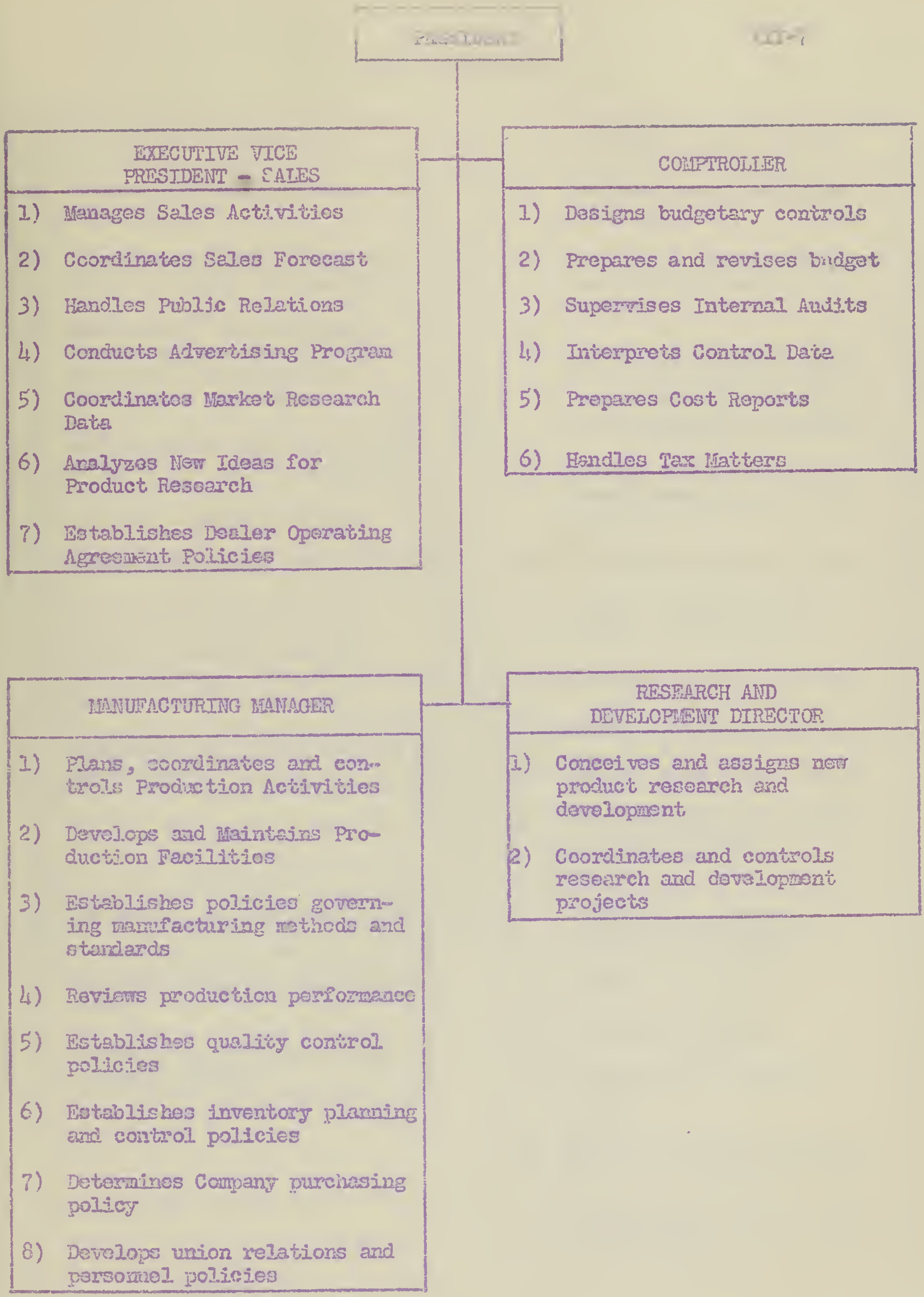
Proposed
Operating Organisation Chart
W. & L. E. Gurley
June 3, 1955

should be given to the duties and responsibilities assigned these positions, as shown on Figure XII-3, and that qualified personnel should be appointed to fill them.

Recommendations

The organization chart as proposed by this survey group was drawn up employing modern principles of company organization. It is realized that there may appear to be a large number of positions; one or more of them, however, may be filled by the same person. In line with the proposed chart it is suggested that:

1) The organization chart as proposed be fully analyzed as to its adaptability to W. & L. E. Gurley.
2) The President clearly delegate authorities and responsibilities for routine operations to his subordinates, as shown on Figures XII-3 and XII-9.
3) The President be given full responsibility for operation of the Company under policies determined by the Board of Directors.
4) The Chairman of the Board of Directors not concern himself directly with daily operations of the Company.
5) All subordinates be fully informed of their duties, authorities and responsibilities, preferably in writing, and that the informal lines of authority be reduced to an absolute minimum.



PRESIDENT

EXECUTIVE VICE PRESIDENT - SALES

1) Manages Sales Activities
2) Coordinates Sales Forecast
3) Handles Public Relations
4) Conducts Advertising Program
5) Coordinates Market Research Data
6) Analyzes New Ideas for Product Research
7) Establishes Dealer Operating Agreement Policies

COMPTROLLER

1) Designs budgetary controls
2) Prepares and revises budget
3) Supervises Internal Audits
4) Interprets Control Data
5) Prepares Cost Reports
6) Handles Tax Matters

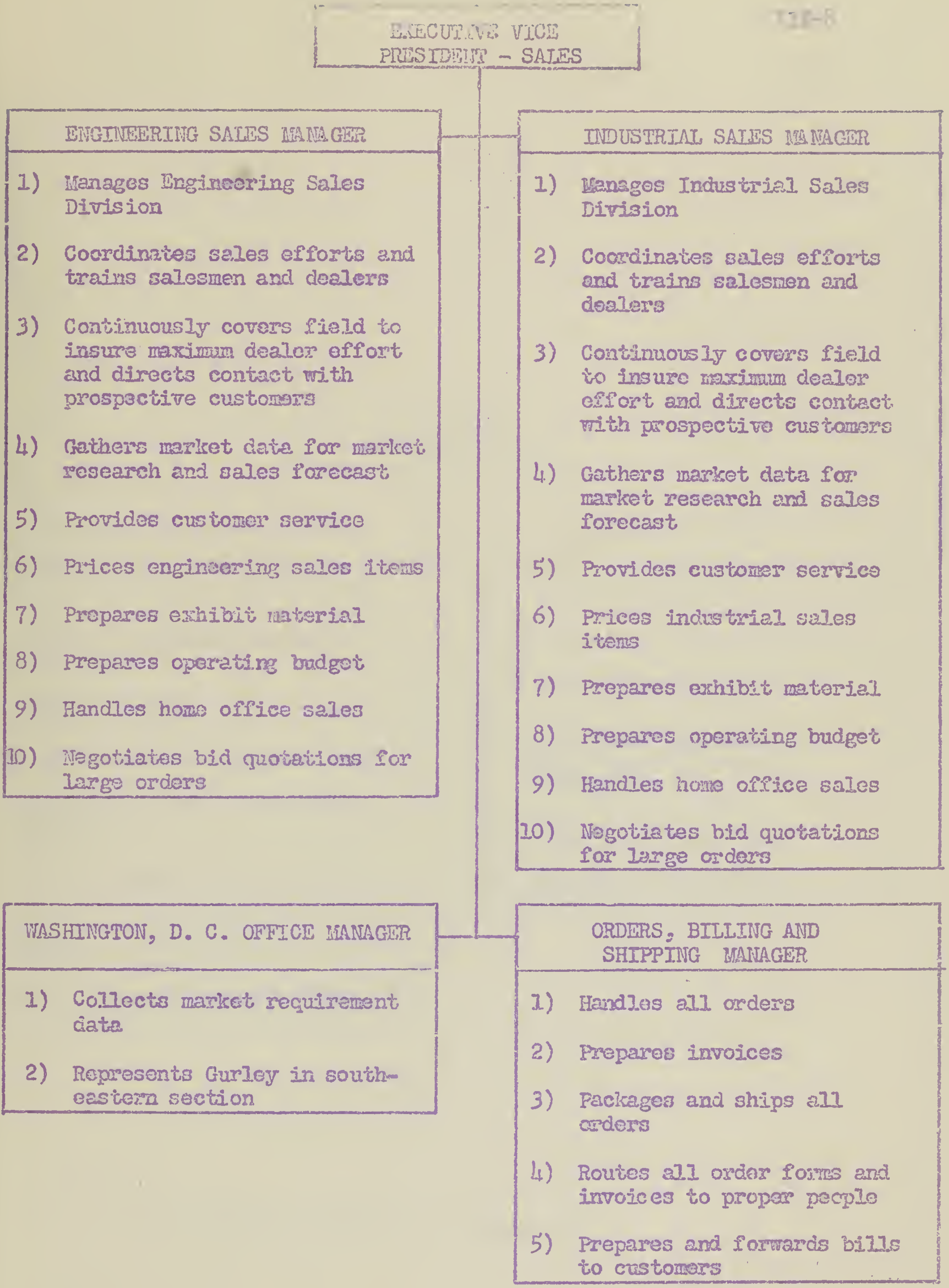
MANUFACTURING MANAGER

1) Plans, coordinates and controls Production Activities
2) Develops and Maintains Production Facilities
3) Establishes policies governing manufacturing methods and standards
4) Reviews production performance
5) Establishes quality control policies
6) Establishes inventory planning and control policies
7) Determines Company purchasing policy
8) Develops union relations and personnel policies

RESEARCH AND DEVELOPMENT DIRECTOR

1) Conceives and assigns new product research and development
2) Coordinates and controls research and development projects

Figure XII-3 Functions of Top Management



EXECUTIVE VICE PRESIDENT - SALES

ENGINEERING SALES MANAGER

1) Manages Engineering Sales Division
2) Coordinates sales efforts and trains salesmen and dealers
3) Continuously covers field to insure maximum dealer effort and directs contact with prospective customers
4) Gathers market data for market research and sales forecast
5) Provides customer service
6) Prices engineering sales items
7) Prepares exhibit material
8) Prepares operating budget
9) Handles home office sales
10) Negotiates bid quotations for large orders

INDUSTRIAL SALES MANAGER

1) Manages Industrial Sales Division
2) Coordinates sales efforts and trains salesmen and dealers
3) Continuously covers field to insure maximum dealer effort and directs contact with prospective customers
4) Gathers market data for market research and sales forecast
5) Provides customer service
6) Prices industrial sales items
7) Prepares exhibit material
8) Prepares operating budget
9) Handles home office sales
10) Negotiates bid quotations for large orders

WASHINGTON, D. C. OFFICE MANAGER

1) Collects market requirement data
2) Represents Gurley in southeastern section

ORDERS, BILLING AND SHIPPING MANAGER

1) Handles all orders
2) Prepares invoices
3) Packages and ships all orders
4) Routes all order forms and invoices to proper people
5) Prepares and forwards bills to customers

Figure XII-4 Functions of Executive Vice President - Sales

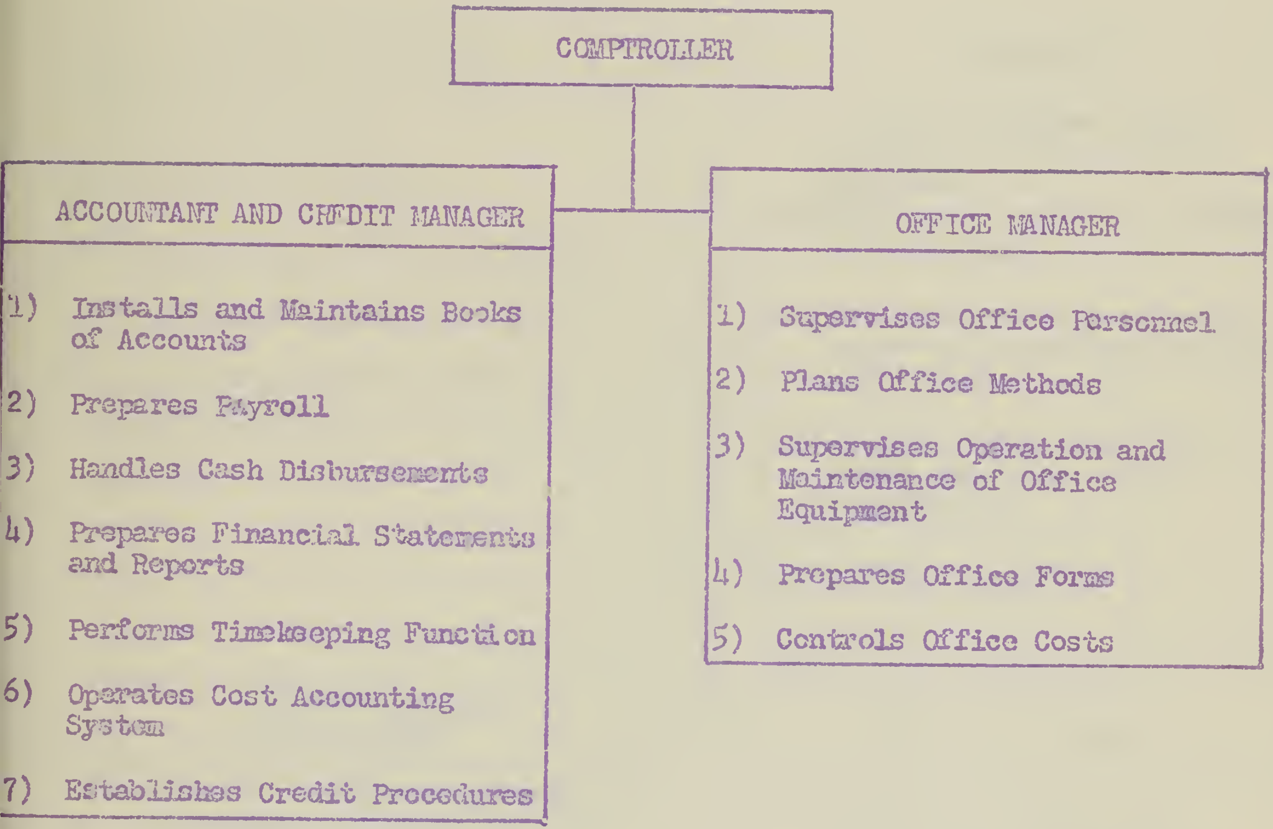
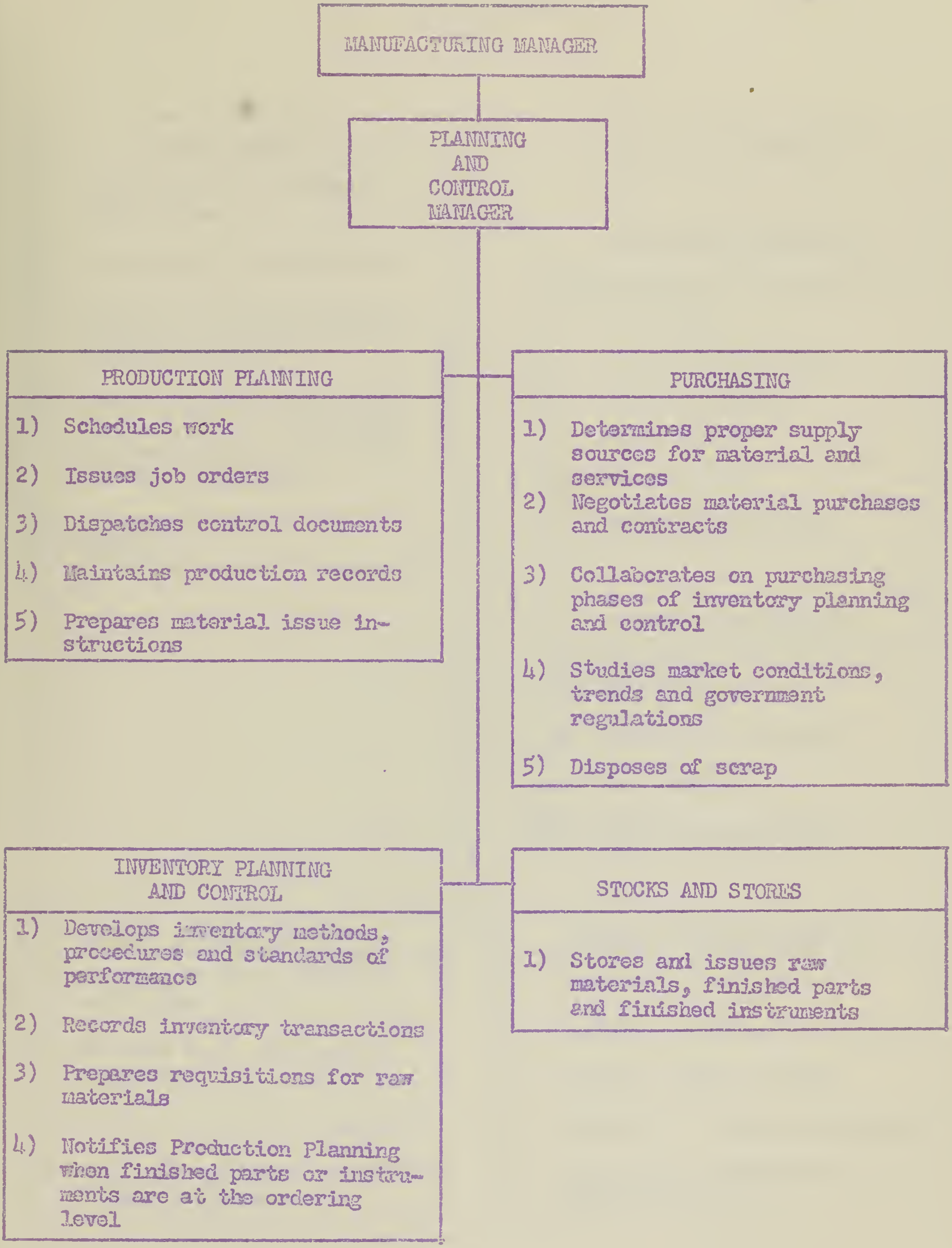

COMPTROLLER
ACCOUNTANT AND CREDIT MANAGER
1) Installs and Maintains Books of Accounts
2) Prepares Payroll
3) Handles Cash Disbursements
4) Prepares Financial Statements and Reports
5) Performs Timekeeping Function
6) Operates Cost Accounting System
7) Establishes Credit Procedures
OFFICE MANAGER
1) Supervises Office Personnel
2) Plans Office Methods
3) Supervises Operation and Maintenance of Office Equipment
4) Prepares Office Forms
5) Controls Office Costs

Figure XII-5 Functions of Comptroller



MANUFACTURING MANAGER

PLANNING AND CONTROL MANAGER

PRODUCTION PLANNING

1) Schedules work
2) Issues job orders
3) Dispatches control documents
4) Maintains production records
5) Prepares material issue instructions

PURCHASING

1) Determines proper supply sources for material and services
2) Negotiates material purchases and contracts
3) Collaborates on purchasing phases of inventory planning and control
4) Studies market conditions, trends and government regulations
5) Disposes of scrap

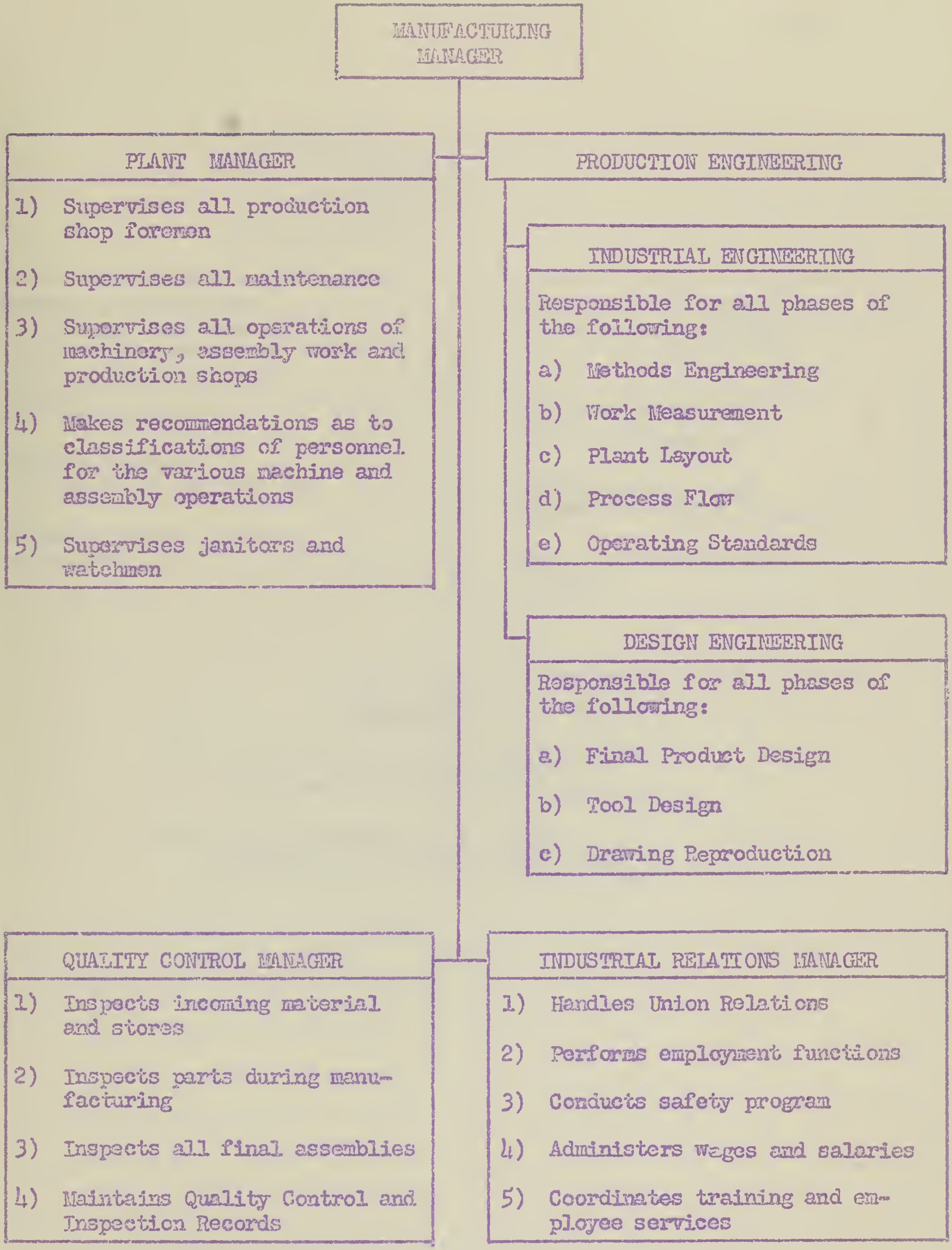
INVENTORY PLANNING AND CONTROL

1) Develops inventory methods, procedures and standards of performance
2) Records inventory transactions
3) Prepares requisitions for raw materials
4) Notifies Production Planning when finished parts or instruments are at the ordering level

STOCKS AND STORES

1) Stores and issues raw materials, finished parts and finished instruments

Figure XII-6 Functional Chart for Planning and Control Manager



MANUFACTURING MANAGER

PLANT MANAGER

1) Supervises all production shop foremen

2) Supervises all maintenance

3) Supervises all operations of machinery, assembly work and production shops

4) Makes recommendations as to classifications of personnel for the various machine and assembly operations

5) Supervises janitors and watchmen

PRODUCTION ENGINEERING

INDUSTRIAL ENGINEERING

Responsible for all phases of the following:

a) Methods Engineering

b) Work Measurement

c) Plant Layout

d) Process Flow

e) Operating Standards

DESIGN ENGINEERING

Responsible for all phases of the following:

a) Final Product Design

b) Tool Design

c) Drawing Reproduction

QUALITY CONTROL MANAGER

1) Inspects incoming material and stores

2) Inspects parts during manufacturing

3) Inspects all final assemblies

4) Maintains Quality Control and Inspection Records

INDUSTRIAL RELATIONS MANAGER

1) Handles Union Relations

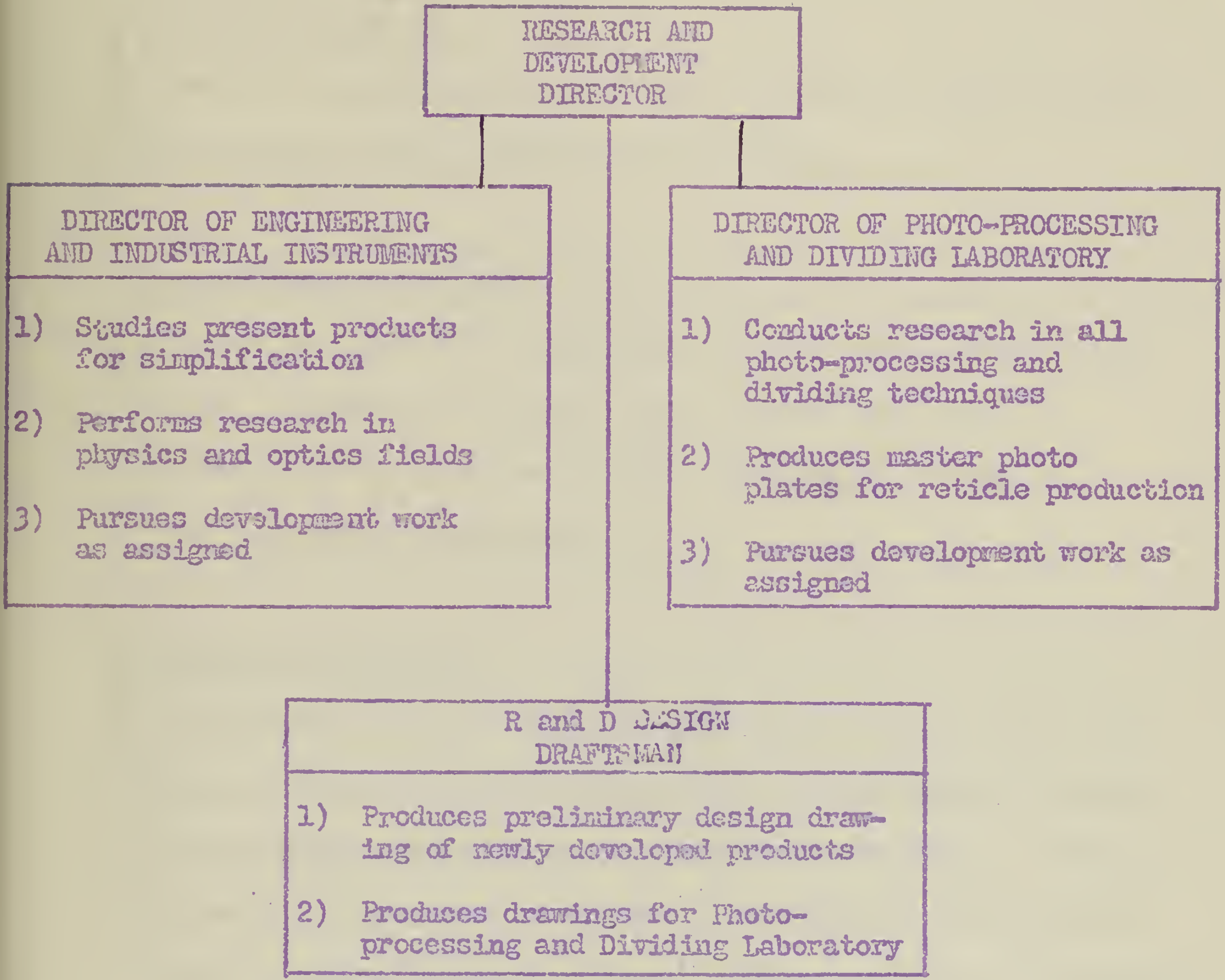
2) Performs employment functions

3) Conducts safety program

4) Administers wages and salaries

5) Coordinates training and employee services

Figure XII-7 Functional Chart for Manufacturing Manager



RESEARCH AND DEVELOPMENT DIRECTOR

DIRECTOR OF ENGINEERING AND INDUSTRIAL INSTRUMENTS

1) Studies present products for simplification
2) Performs research in physics and optics fields
3) Pursues development work as assigned

DIRECTOR OF PHOTO-PROCESSING AND DIVIDING LABORATORY

1) Conducts research in all photo-processing and dividing techniques
2) Produces master photo plates for reticle production
3) Pursues development work as assigned

R and D DESIGN DRAFTSMAN

1) Produces preliminary design drawing of newly developed products
2) Produces drawings for Photo-processing and Dividing Laboratory

Figure XII-8 Functional Chart for Research and Development

POLICY COMMITTEES

ADVISORY COMMITTEE

Act in a consulting capacity to the President on major questions of Company policy, procedures and control.

MANUFACTURING COMMITTEE

Review, analysis and coordination of basic manufacturing policies, procedures and methods of all operating groups and divisions to promote the greatest possible interchange of information and cooperation.

MARKETING COMMITTEE

Review and coordinate marketing activities of the various operating and selling units of the Company and coordinate them with other management functions, especially manufacturing. Develop plans for more effective analysis and control of distribution costs, pricing, inventory control, market analysis and forecasts, product service, basic advertising, trademark forecasting in so far as they affect the Company as a whole.

Figure XII-9 Functions of Policy Committees

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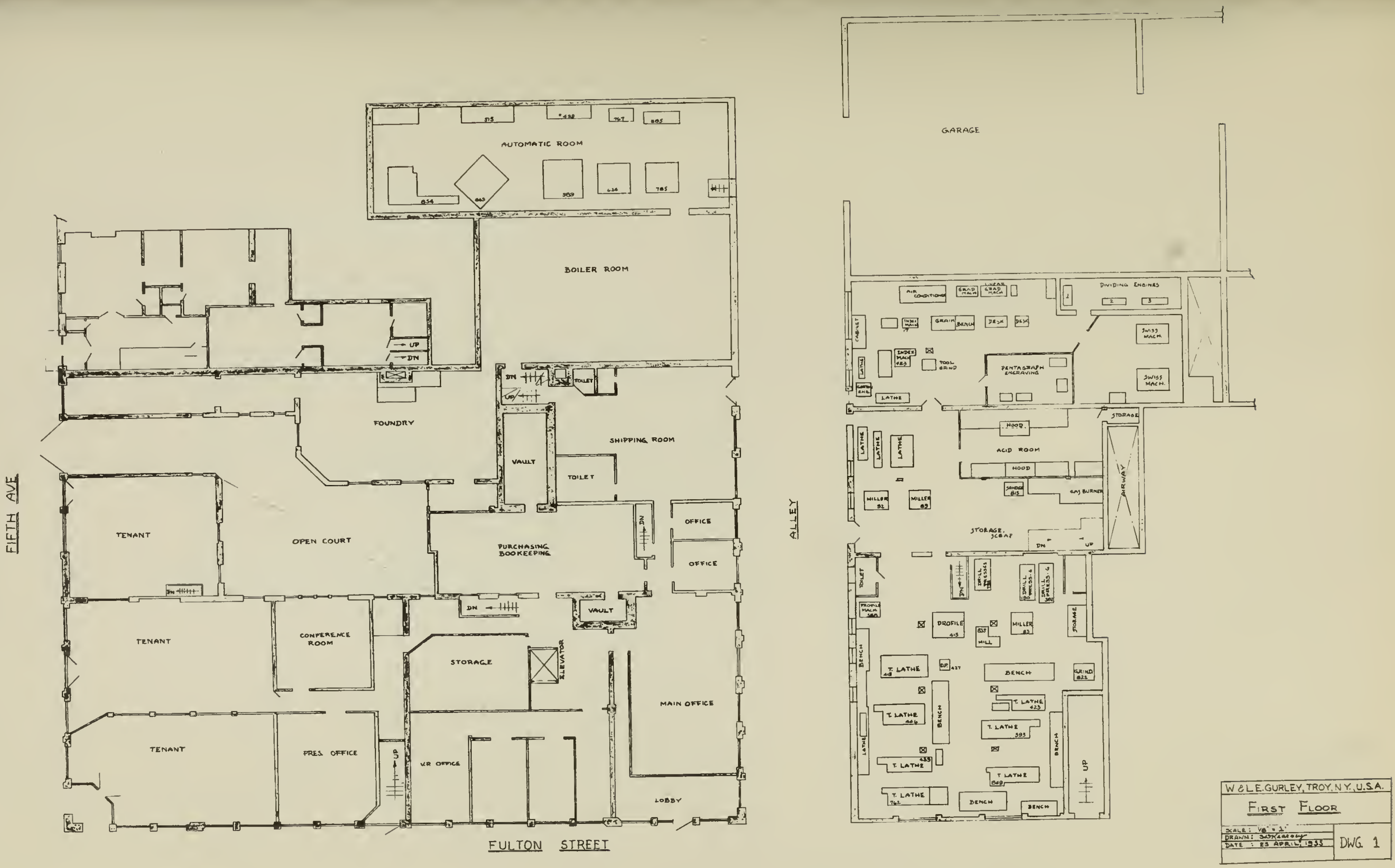

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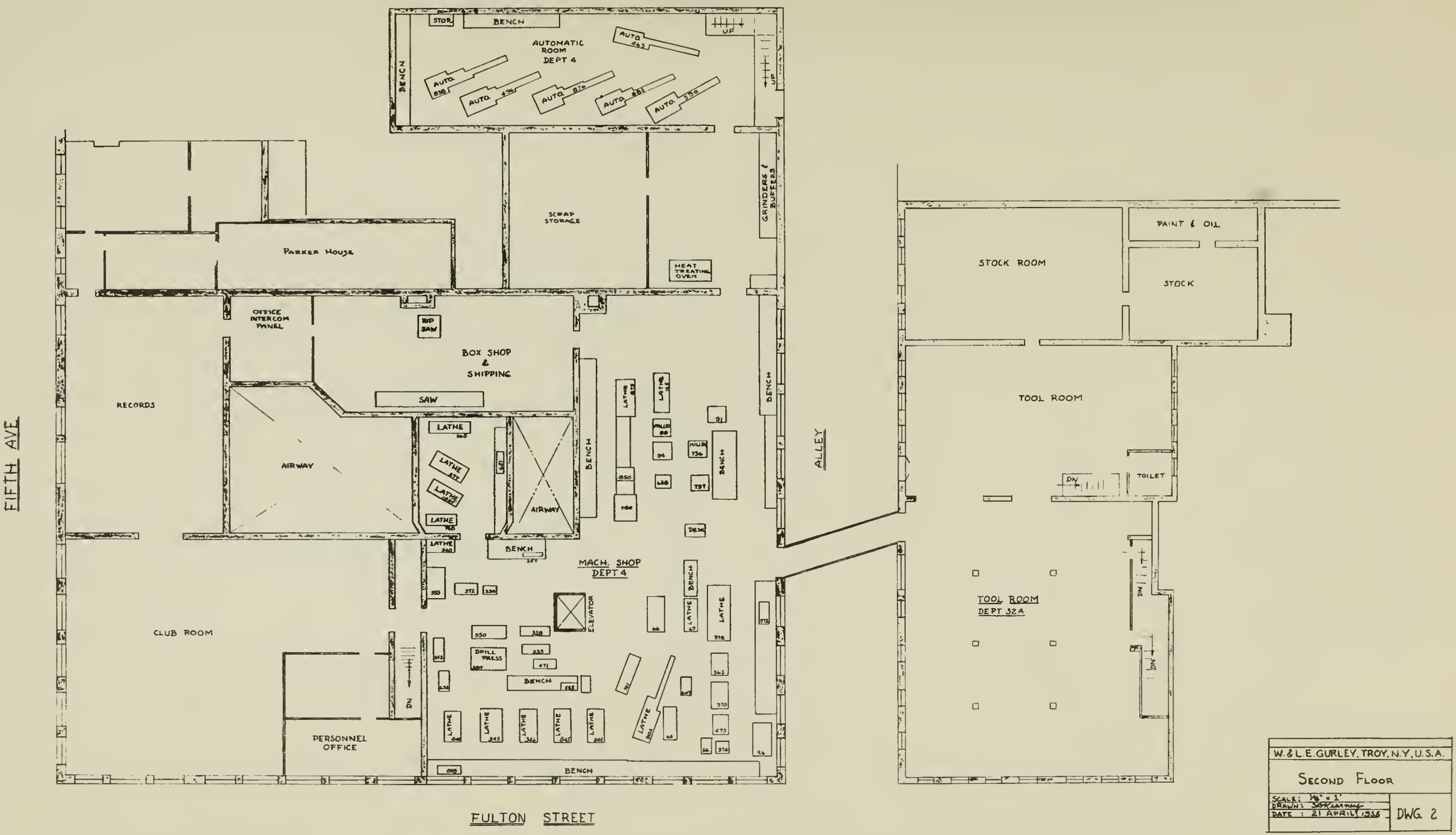

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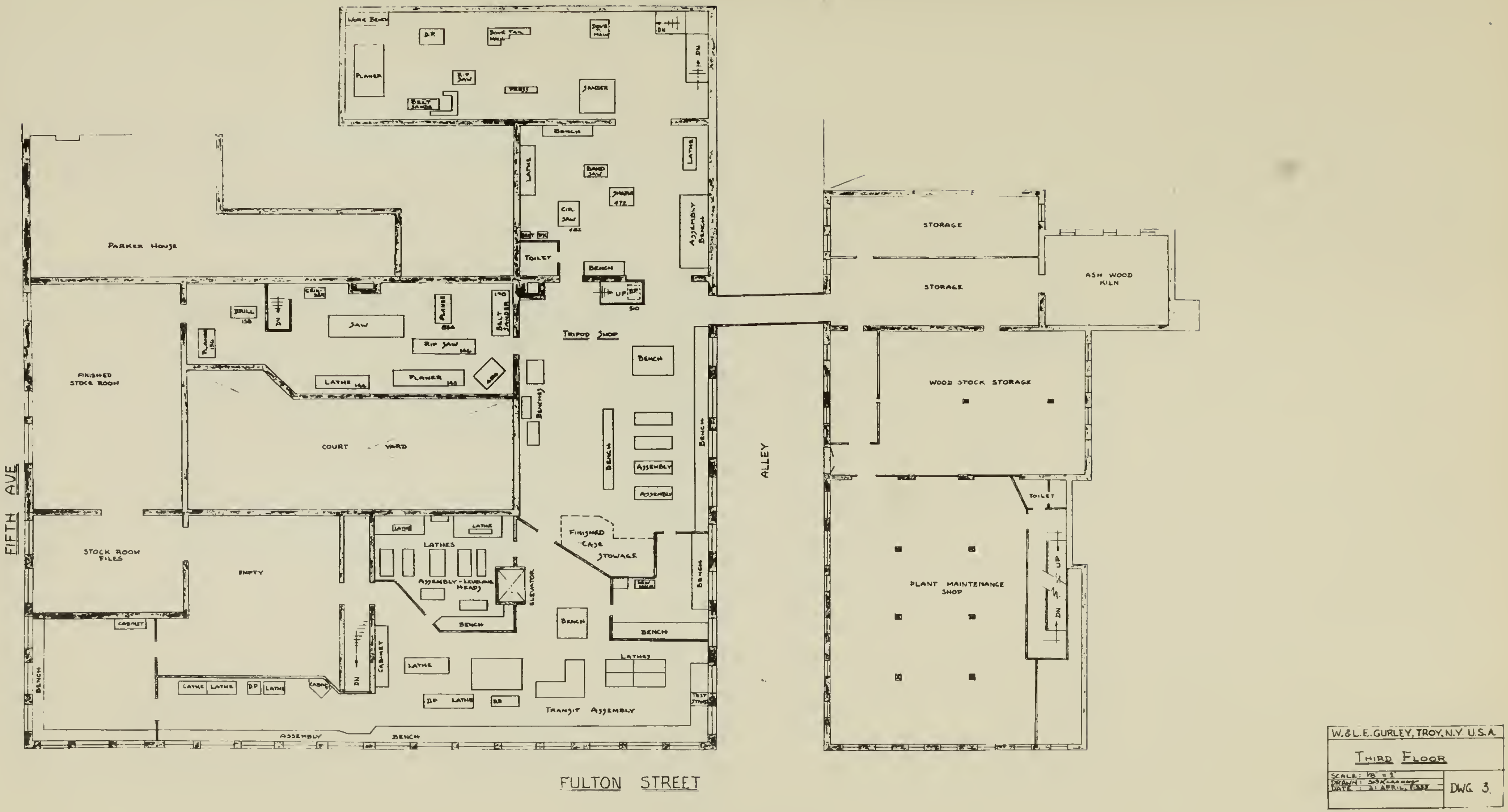
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EMPTY
COURT YARD
TRIPOD SHOP
WORK BENCH
D.P.
DOVE TAIL MACH
DOVE TAIL MACH
DN
PLANER
RIP SAW
PRESS
SANDER
BELT SANDER
BENCH
LATHE
BAND SAW
SHAPER 472
CIR. SAW 482
ASSEMBLY BENCH
TOILET
BENCH
UP
D.P.
510
DRILL 158
DN
SAW
PLANER 884
BELT SANDER 140
RIP SAW 144
PLANER 136
LATHE 144
PLANER 148
BENCHES
BENCH
ASSEMBLY
ASSEMBLY
BENCH
FINISHED CASE STOWAGE
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ASSEMBLY - LEVELING HEADS
ELEVATOR
BENCH
BENCH
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LATHE
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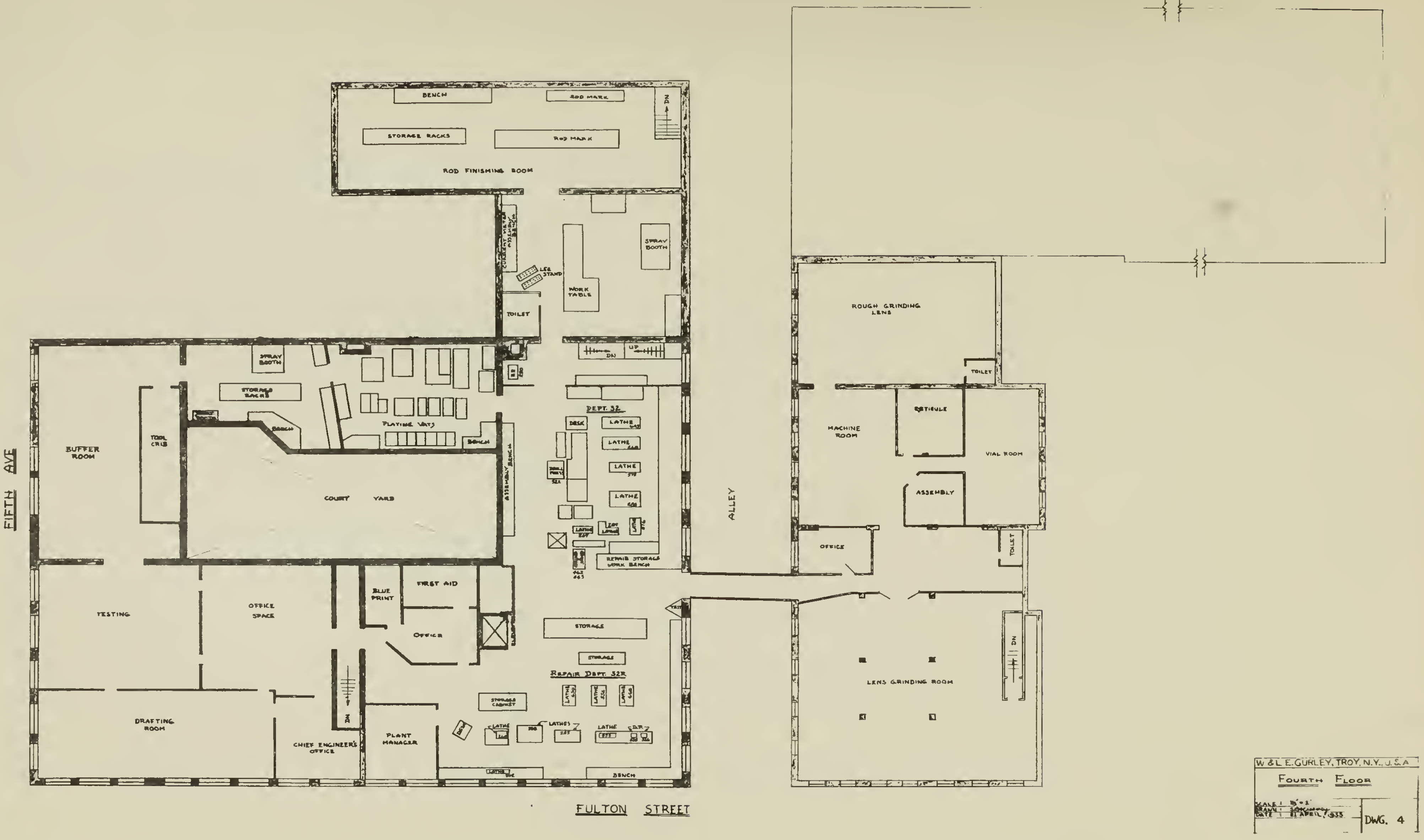
PLANT MAINTENANCE SHOP



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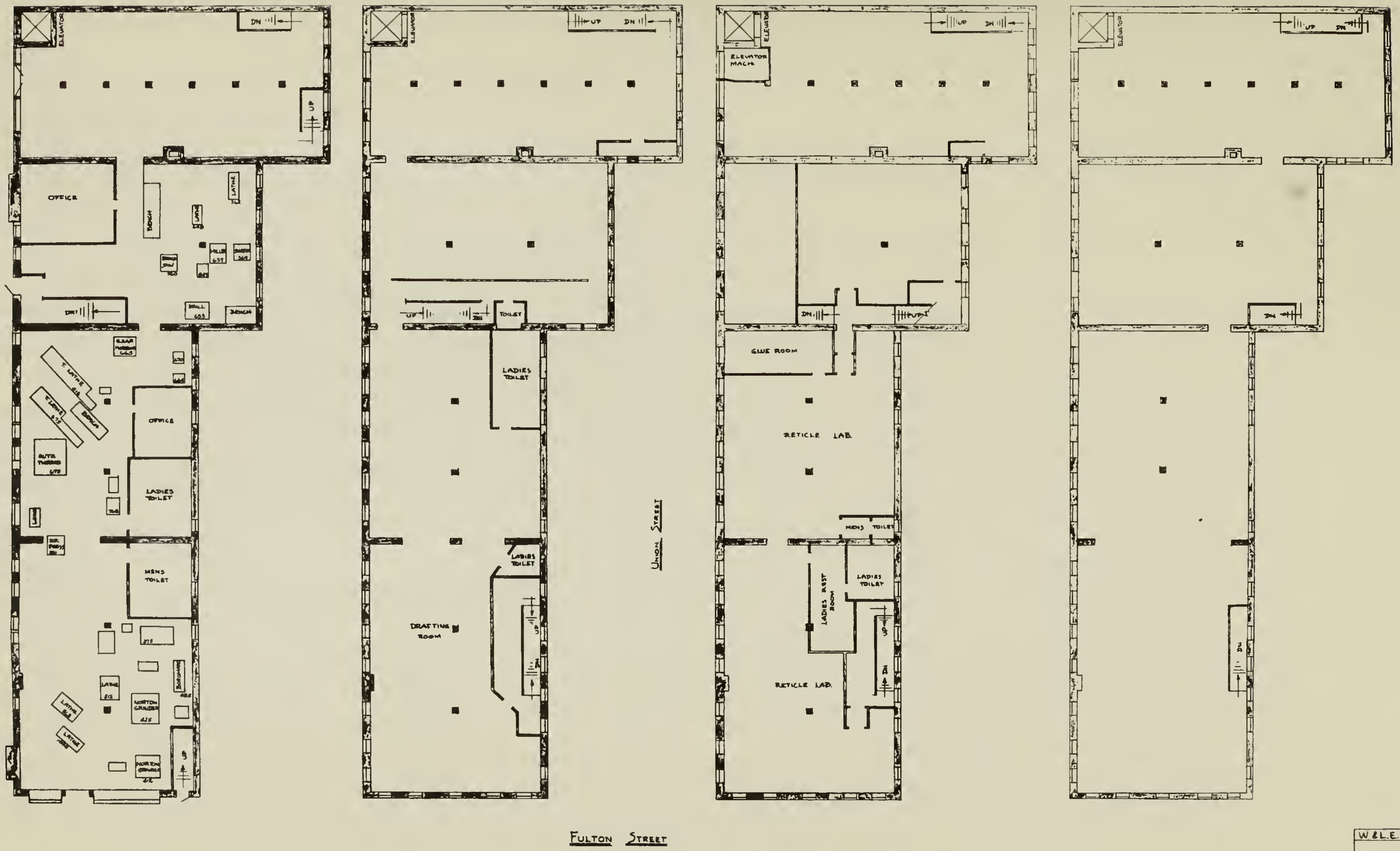

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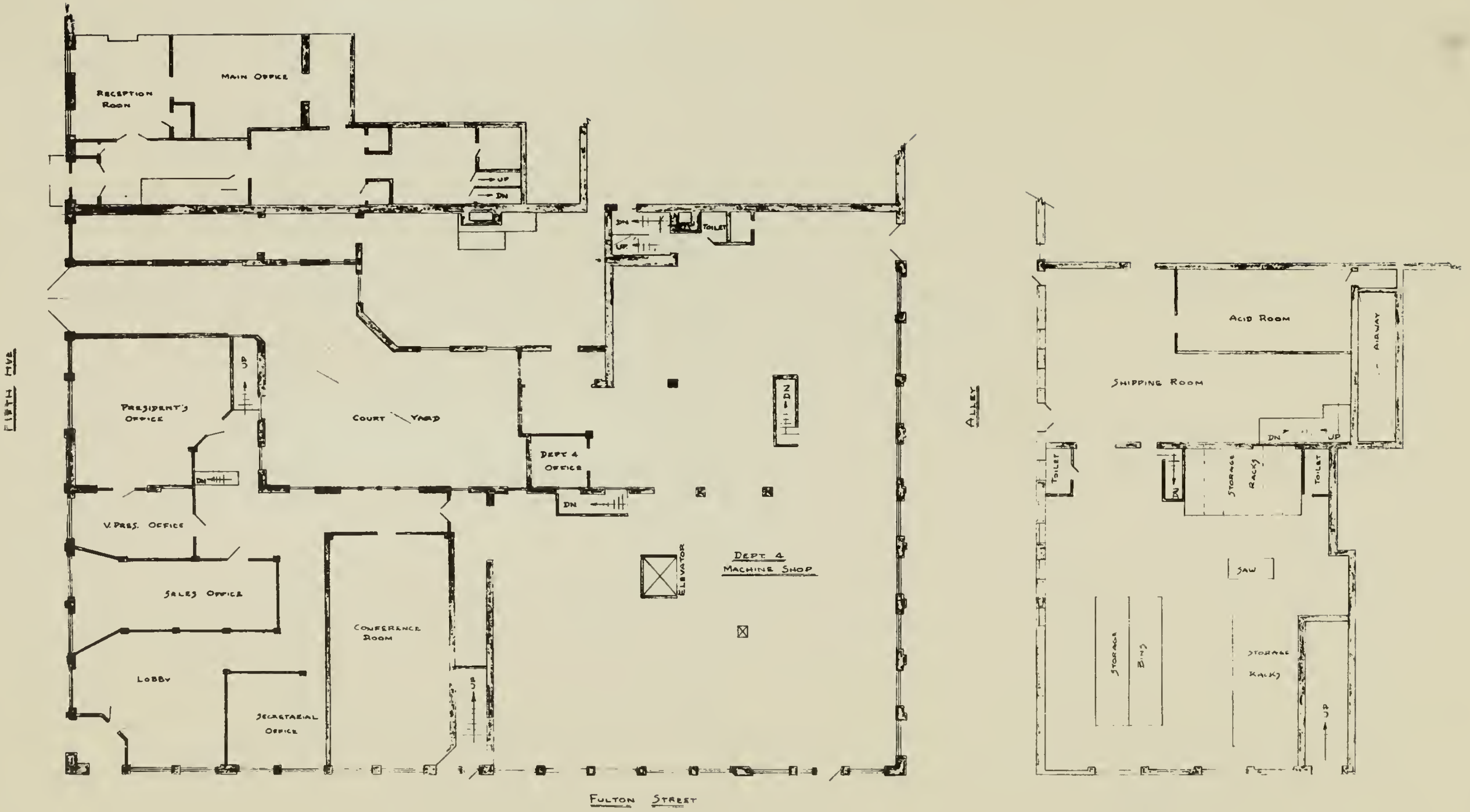

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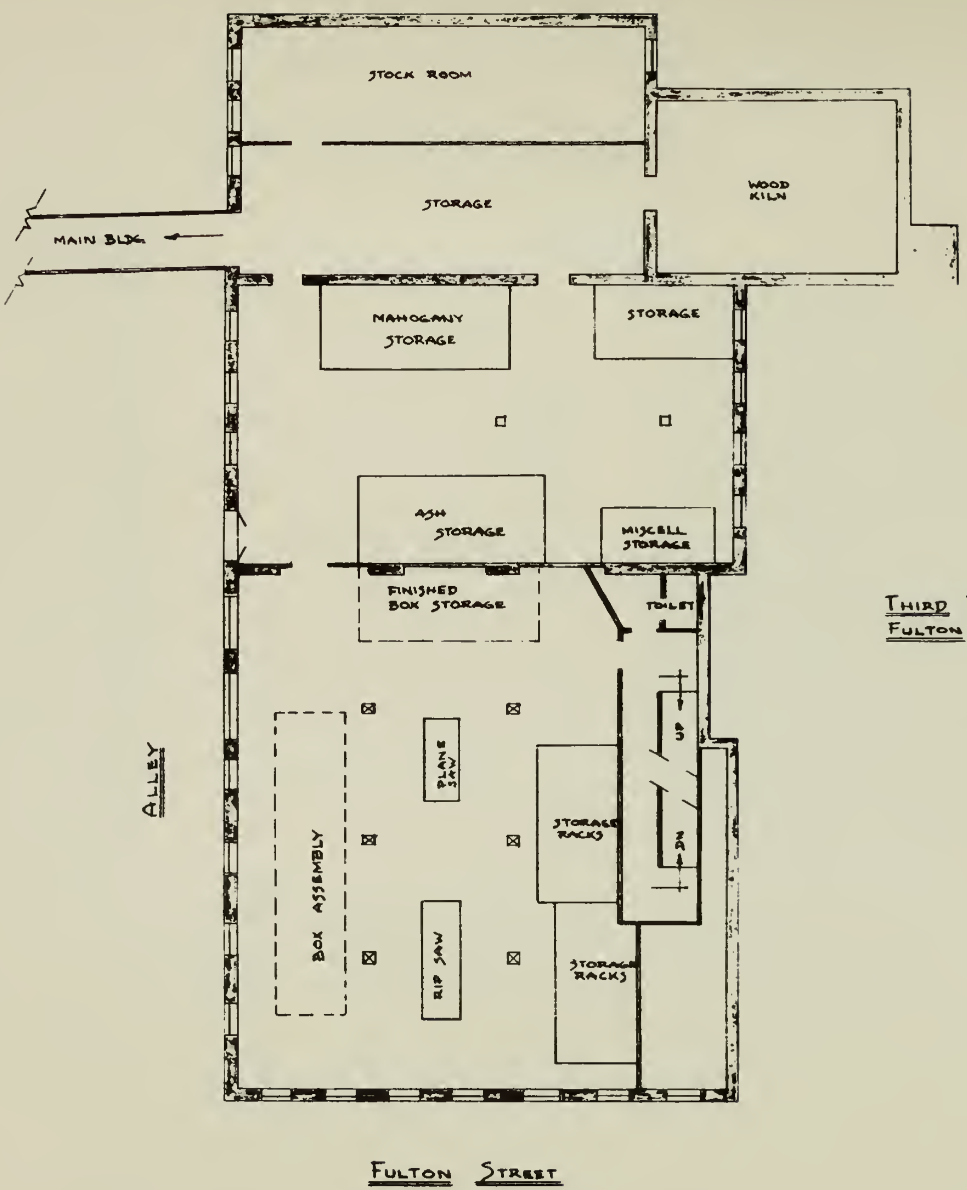

THIRD FLOOR
FULTON BUILDING

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PROPOSAL

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